GENERAL SPECIFICATION

FOR

FIRE SERVICE INSTALLATION

IN

GOVERNMENT BUILDINGS

OF

THE HONG KONG SPECIAL ADMINISTRATIVE REGION

2007 EDITION

ARCHITECTURAL SERVICES DEPARTMENT
THE GOVERNMENT OF THE HONG KONG SPECIAL ADMINISTRATIVE REGION

PREFACE

This General Specification aims to lay down the technical requirements of materials and equipment, the standards of workmanship, the requirements on testing and commissioning as well as requirements on document submissions for fire service installation in Government Buildings of the Hong Kong Special Administrative Region (HKSAR).

The 2007 edition of this General Specification was developed based on its 2001 edition by the Fire Service, LPG, Catering and Plumbing Specialist Support Group that was established under the Building Services Branch Technical Information and Research & Development Committee. Apart from the adoption of a new arrangement that gives the document a more compact and well-defined structure, this new edition comprises revisions to incorporate updated international standards and covers technological developments which find applications in Hong Kong. The other emphasis is on green initiatives, e.g. reduction of construction waste and enhancement of client satisfaction on completed projects. This is in line with the department's endeavour to reduce the environmental burden on our neighbours and help to preserve common resources while improving the quality of our service.

With the benefit of information technology, electronic version of this new edition is to be viewed on and free for download from the Architectural Services Department (ArchSD) Internet homepage. As part of the Government's efforts to limit paper consumption, hard copies of this General Specification will not be put up for sale.

The draft of this edition has been circulated to stakeholders within and external to the Government before finalization. Nevertheless, the Architectural Services Department welcomes comments on its contents at anytime since the updating of this General Specification is a continuous process for the inclusion of any developments that can help meeting the needs of our community.

DISCLAIMER

This General Specification is solely compiled for a fire service installation carried out for or on behalf of the ArchSD in Government buildings of the HKSAR.

There are no representations, either expressed or implied, as to the suitability of this General Specification for purposes other than that stated above. Users who choose to adopt this General Specification for their works are responsible for making their own assessments and judgement of all information contained here. The ArchSD does not accept any liability and responsibility for any special, indirect or consequential loss or damage whatsoever arising out of or in connection with the use of this General Specification or reliance placed on it.

The materials contained in this document may not be pertinent or fully cover the extent of the installation in non-government buildings and there is no intimated or implied endorsement of the sales, supply and installation of the materials and equipment specified in this General Specification within the territory of the HKSAR.

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PART A – SCOPE AND GENERAL REQUIREMENTS

SECTION A1

SCOPE OF SPECIFICATION

A1.1 INSTALLATION TO COMPLY WITH THIS GENERAL SPECIFICATION

The fire service installation shall comply with this General Specification which details the intrinsic properties (including materials and workmanship) of the installation, in so far as it is not overridden by the General Conditions of Contract, Special Conditions of Contract, Particular Specification for the Works, Drawings and/or written instructions of the Architect. The fire service installation shall include but not limited to hydrant/hose reel system, automatic sprinkler system, manual and automatic fire alarm system, audio/visual advisory system, gaseous extinguishing system, portable appliances, emergency lighting, exit sign, emergency generator, ventilation/air conditioning control system, pressurisation of staircases system, smoke extraction system and all associated electrical equipment, control and wiring.

A1.2 SCOPE OF THE WORKS

This General Specification, Particular Specification, Tender Equipment Schedule and Drawings detail the performance requirements of the Works. The Works to be carried out in accordance with this General Specification shall include the design where specified, installation and supply of all materials necessary to form a complete installation including any necessary tests, adjustments, commissioning and maintenance as prescribed and all other incidental sundry components together with the necessary labour for installing such components, for the proper operation of the installation.

A1.3 TERMS, DEFINITIONS AND ABBREVIATIONS

In this General Specification, the following words or expressions shall have the meanings assigned to them except when the context otherwise requires: -

A1.3.1 Terms and Definitions

Architect	The Architect or the Maintenance Surveyor or the Supervising Officer as defined in the Contract.
Building Contractor	The Contractor employed by the Employer for the execution of the Works as defined in the Contract or the contractor separately employed by the Employer to execute the builder's work associated with the Works as appropriate.

Contract	The Contract defined in the General Conditions of Contract for the Works or the Sub-contract defined in the Specialist Sub-contract for the Works or the Sub-contract defined in the Nominated Sub-contract for the Works as appropriate
Contractor	The contractor employed by the Employer or the Specialist Sub-contractor employed by the Building Contractor or the Nominated Sub-contractor nominated by the Architect for the execution of the Works as appropriate
Tender	The Contractor's tender for the Works Contract or the Specialist Sub-contractor's tender for the Works Specialist Sub-contract or the Nominated Sub-contractor's tender for the Works Nominated Sub-contract as appropriate

A1.3.2 Abbreviations

ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
BS	British Standards, including British Standard Specifications and British Standard Codes of Practice, published by the British Standards Institution
BSB	Building Services Branch, Architectural Services Department of the Hong Kong Special Administrative Region
BS EN	European Standard adopted as British Standard
EE_TC	Testing and Commissioning Procedure for Electrical Installation in Government Buildings, Hong Kong, issued by the Architectural Services Department, the HKSAR
EMSD	Electrical and Mechanical Services Department of the Hong Kong Special Administrative Region
FM	Factory Mutual, USA.
FOC	Fire Offices' Committee, UK.
FRC	Code of Practice for Fire Resisting Construction published by the Buildings Department, the HKSAR
FRP	Fire resistance period

FSD	Fire Services Department of the Hong Kong Special Administrative Region
FSDCoP	Codes of Practice for Minimum Fire Service Installations and Equipment and Inspection, Testing and Maintenance of Installations and Equipment published by Fire Services Department, the HKSAR
FS_TC	Testing and Commissioning Procedure for Fire Service Installation in Government Buildings, Hong Kong, issued by the Architectural Services Department, the HKSAR
HKSAR	Hong Kong Special Administrative Region
IEC	International Electrotechnical Commission Publications
IEE Wiring Regulations	Regulations for Electrical Installations (BS 7671: 2001) published by the Institution of Electrical Engineers, UK
ISO	International Operation for Standardization Publications
MoA	Code of Practice for Means of Access for Firefighting and Rescue published by the Buildings Department, the HKSAR
MoE	Code of Practice for the Provision of Means of Escape In case of Fire published by the Buildings Department, the HKSAR
NFPA	National Fire Protection Association, USA
LPC	Loss Prevention Council, UK
LPCB	Loss Prevention Certification Board, UK
PNxx	Pressure Rating xx BAR at $23^{o}C$
PBFE	Performance based fire engineering (or performance based fire safety engineering or performance based fire protection engineering) studies, approaches, analyses, assessment, applications and/or similar works adopting fire engineering principles

RFSI	Related Fire Service Installation and shall include all fire service installations in a building or project that are carried out by others and not included in the Works under Fire Service Installation, but they are required to be inspected and accepted by the FSD on completion. Related Fire Service Installation shall include, but not limited to, water supplies, supply tanks, ring main systems, street hydrants, interfacing signals between fire service system and various electrical and mechanical systems, emergency generator, emergency lighting, exit sign, pressurisation of staircases system, smoke extraction system, and fixed automatically operated approved appliances.
RFSP	Related Fire Service Provisions and shall include all building components, fixtures, installations and provisions, but excluding fire service installation, for fulfilling the fire safety requirements of a building or project, and they are required to be inspected and accepted by the FSD on completion. Related Fire Service Provisions shall include, but not limited to, fireman lifts, emergency vehicular access, fire dampers, fire doors, fire shutters, fire seals, fire insulation, fire fighting and rescue stairways, materials for separation of compartments, passive fire protection, ventilation system, exhaust system for gas flooding system, electrical installation, cubicle switchboard installation, telephone wiring, provisions for dangerous goods stores, labels and signs, etc.
UL	Underwriters' Laboratory, USA
WSD	Water Supplies Department of the Hong Kong Special Administrative Region

A1.4 SINGULAR AND PLURAL

Words importing the singular only also include the plural and vice versa where the context requires.

A1.5 DESIGN RESPONSIBILITY

Where design is specified for any part of the Works, the Contractor shall design the fire service installation to comply with the statutory requirements as well as the requirements in the Specification. Where design is not specified, the Contractor shall still develop the design shown in the Drawings or in the Particular Specification, complete the detailed design and installation details of the whole fire service installation and select the most appropriate equipment design to comply with the statutory requirements and all other requirements of the Specification. All design drawings, calculation and installation details shall be submitted to the Architect for approval.

Where design is specified, all design shall be checked and endorsed by a Registered Professional Engineer in Hong Kong under CAP 409 in approved disciplines (or person having equivalent approved professional qualification) specialised and experienced in fire service installation design employed by the Contractor and approved by the Architect.

For design of a minor fire service installation, ('minor' means the total fire service installation cost in the Works equivalent to or less than the cost limit under the category of Fire Service Installation Group I in the List of the Government of HKSAR), the design can be checked and endorsed by a qualified and experienced staff of the Contractor when it is approved by the Architect. Where approval is not obtained, the design shall be checked and endorsed by a Registered Professional Engineer in Hong Kong under CAP 409 in approved disciplines (or person having equivalent approved professional qualification).

A 1.6 USE OF APPROVED EQUIPMENT

Fire service equipment used for the Works shall be of approved type and shall possess the relevant approval by the FSD or by the product certification bodies acceptable to the FSD as stipulated in the FSD Circular Letters. For fire service equipment listed in FSD Circular Letter No. 1/2007 and 4/1998 requiring FSD's approval or product certification bodies' approval, the Contractor shall select and submit to the Architect for approval only those equipment and materials that have been approved by relevant authorities including the FSD or the product certification bodies. Copies of the approval letters, certificates and relevant approval documents from the FSD and product certification bodies shall be submitted together with the equipment catalogue to the Architect for approval. For equipment that has been exempted from approval by the FSD or does not require the approval of the FSD, the Contractor shall state such information in the submission to the Architect and shall provide the evidence or documentary proof where necessary on such exemption. The Contractor shall seek prior approval from the FSD if new system or new type of equipment is proposed.

The equipment selected by the Contractor shall also possess the approval by the relevant authorities such as WSD. Copies of the approval letters or approval documents from the WSD etc. shall be submitted together with the equipment catalogue to the Architect for approval.

The approval by the FSD, WSD, product certification bodies and/or any other parties shall not exempt materials and equipment from complying with all other requirements in this General Specification. Materials and equipment approved by the FSD, WSD and/or product certification bodies will not be accepted automatically. Only materials and equipment that can comply with all the requirements in the Specification and in the Contract will be considered for acceptance.

SECTION A2

STATUTORY OBLIGATIONS AND OTHER REGULATIONS

A2.1 STATUTORY OBLIGATIONS AND OTHER REQUIREMENTS

The fire service installation shall comply with the following : -

A2.1.1 Statutory Obligations

(a) Electricity Ordinance, Chapter 406, and other subsidiary legislation made under the Ordinance;

(b) Fire Service (Installation and Equipment) Regulations, Fire Services Ordinance, Chapter 95, and other subsidiary legislation made under the Ordinance;

(c) Noise Control Ordinance, Chapter 400, and other subsidiary legislation made under the Ordinance;

(d) Water Pollution Control Ordinance, Chapter 358, and other subsidiary legislation made under the Ordinance;

(e) Air Pollution Ordinance, Chapter 311, and other subsidiary legislation made under the Ordinance;

(f) Waste Disposal Ordinance, Chapter 354 and other subsidiary legislation made under the Ordinance; and

(g) Environmental Impact Assessment Ordinance, Chapter 499 and other subsidiary legislation made under the Ordinance.

(h) Ozone Layer Protection, Chapter 403, and other subsidiary legislation made under the Ordinance;

(i) Waterworks Ordinance, Chapter 102, and other subsidiary legislation made under the Ordinance;

(j) Dangerous Goods Ordinance, Chapter 295, and other subsidiary legislation made under the Ordinance;

(k) Places of Public Entertainment Ordinance, Chapter 172, and other subsidiary legislation made under the Ordinance;

(l) Buildings Ordinance, Chapter 123, and other subsidiary legislation made under the Ordinance;

(m) Fire Safety (Commercial Premises) Ordinance, Chapter 502, and other subsidiary legislation made under the Ordinance;

(n) Residential Care Homes (Elderly Persons) Ordinance, Chapter 459, and other subsidiary legislation made under the Ordinance;

(o) Radiation Ordinance, Chapter 303, and other subsidiary legislation made under the Ordinance;

(p) Public Health and Municipal Service Ordinance, Chapter 132, Provision of Municipal Service (Reorganisation) Ordinance, Chapter 552, and other subsidiary legislation made under the Ordinances;

(q) Child Care Services Ordinance, Chapter 243, and other subsidiary legislation made under the Ordinance;

(r) Hotel and Guesthouse Accommodation Ordinance, Chapter 349, and other subsidiary legislation made under the Ordinance;

(s) Fire Safety (Buildings) Ordinance, Chapter 572, and other subsidiary legislation made under the Ordinances;

(t) Timber Stores Ordinance, Chapter 464, and other subsidiary legislation made under the Ordinances;

(u) Licensing requirements under relevant statutory Regulations;

(v) All other relevant statutory Regulations currently in force.

A.2.1.2 Other Requirements

(a) Code of Practice for the Electricity (Wiring) Regulations published by the Electrical and Mechanical Services Department, the Government of the HKSAR;

(b) Codes of Practice for Minimum Fire Service Installations and Equipment and Inspection, Testing and Maintenance of Installations and Equipment published by Fire Services Department, the Government of the HKSAR (hereinafter referred as FSDCoP);

(c) All requirements of the FSD including FSD Circular Letters and Fire Protection Notices of the Fire Services Department, the HKSAR (hereinafter referred collectively as FSD Requirements and Circular Letters);

(d) Loss Prevention Council Rules for Automatic Sprinkler Installations (including all the LPC Technical Bulletins, Notes, Commentary, and Recommendation) incorporating BS EN 12845:2003, FSD Circular Letter No. 3/2006, and all the subsequent amendments by the FSD (hereinafter referred collectively as LPC Rules for Sprinkler Installations);

(e) Loss Prevention Council Rules for Automatic Fire Detection and Alarm Installations for Protection of Property (Schedule for the use of BS 5839 : Part 1 :1988), BS 5839 : Part 1:1988, FSD Circular Letter No. 1/2002, and all the subsequent amendments by the FSD (hereinafter referred collectively as LPC Rules for AFA Installations);

(f) Rules of Fire Offices' Committee (Foreign), United Kingdom, for the Installation of External Drenchers;

(g) Code of Practice for Energy Efficiency of Electrical Installations issued by the Electrical & Mechanical Services Department, the Government of the HKSAR;

(h) Code of Practice for Energy Efficiency of Air Conditioning Installations issued by the Electrical & Mechanical Services Department, the Government of the HKSAR;

(i) General Specification for Electrical Installation in Government Buildings of The Hong Kong Special Administrative Region issued by the Architectural Services Department (hereinafter referred as General Electrical Specification);

(j) General Specification for Air Conditioning, Refrigeration, Ventilation and Central Monitoring and Control System Installation in Government Building of The Hong Kong Special Administrative Region issued by the Architectural Services Department (hereinafter referred as General A/C Specification);

(k) General Specification for Lift, Escalator and Passenger Conveyor Installation in Government Buildings of The Hong Kong Special Administrative Region issued by the Architectural Services Department (hereinafter referred as General Lift Specification);

(l) General Specification for Building, issued by Architectural Services Department, the HKSAR;

(m) Design Manual: Barrier Free Access 1997 published by the Buildings Department, the Government of the HKSAR;

(n) Hong Kong Waterworks Standard Requirements for Plumbing Installation in Buildings and all the circular letters issued by the Water Supplies Department, The HKSAR.

(o) Testing and Commissioning Procedures issued by the Architectural Services Department, the Government of the HKSAR;

(p) Code of Practice for the Provision of Means of Escape In Case of Fire, Code of Practice for Fire Resisting Construction, and Code of Practice for Means of Access for Firefighting and Rescue published by the Buildings Department, the Government of the HKSAR;

(q) British Standards and Codes of Practice issued by the British Standards Institution, or other internationally recognised equivalent standards acceptable to the Architect and demonstrated to be equivalent in terms of the type of construction, functions, performance, general appearance and standard of quality of manufacture and approved by the Architect; and

(r) Where indicated, the codes, standards and guidelines issued by the following international institutions, or other internationally recognised equivalent standards acceptable to the Architect and demonstrated to be equivalent in terms of the type of construction, functions, performance, general appearance and standard of quality of manufacture and approved by the Architect: -

- Loss Prevention Council, United Kingdom
- National Fire Protection Association, United States
- International Operation for Standardisation
- American National Standard Institute
- Committee for European Normalisation
- Japanese International Standard
- Factory Mutual, United States
- Underwriters' Laboratory, United State

A2.1.3 Safety Requirements

(a) Occupational Safety and Health Ordinance, Chapter 509, and other subsidiary legislation made under the Ordinance;

(b) Factories and Industrial Undertakings Ordinance, Chapter 59, and other subsidiary legislation made under the Ordinance;

(c) Public Health and Municipal Service Ordinance, Chapter 132, Provision of Municipal Service (Reorganisation) Ordinance, Chapter 552, Laws of the Hong Kong Special Administrative Region;

(d) Construction Site (Safety) Regulations; and

(e) Construction Site Safety Manual issued by the Environment, Transport and Works Bureau, the Government of the HKSAR.

A2.1.4 Technical Standards and Requirements

A list of technical standards and quality standards quoted in this General Specification to which the Works shall comply is listed in Annex I.

A list of major technical standards and requirements of Fire Services Department to which the Works shall comply is listed in Annex II and stated in Clauses A2.1.1, A2.1.2 and A2.1.3.

The Works shall comply with the current edition, or the latest edition currently in force, of the listed BS, BS EN, ISO Standards, IEC Standards and Codes of Practice, etc., and other technical standards, quality standards, International Standards, codes of practice, rules, guidelines, design manuals, technical requirements, specifications, etc. quoted in this General Specification including all subsequent amendments, revisions, and standards superseding the standards listed herein which are current at the closing date of the tender of the Contract, unless otherwise specified or unless the latest amendments are not allowed or approved by the relevant authorities under the statutory regulations. Equivalent International Standards may be used if approved by the Architect.

Materials, equipment and products that comply with equivalent technical standards and demonstrated to be equivalent in overall technical substitute on the type of construction, functions, performance, general appearance and standard of quality of manufacture to the standards and requirements listed herein may be submitted to the Architect for consideration and approval.

A2.2 CASE OF CONFLICT

The documents forming the Contract are to be taken as mutually explanatory of one another but in case of ambiguities or discrepancies the same shall be explained by the Architect who shall issue to the Contractor instructions clarifying such ambiguities or discrepancies.

SECTION A3

EXECUTION OF WORKS

A3.1 THE INTERNATIONAL SYSTEM OF UNITS (SI)

The International System of Units (System International d'Unites) of weights and measures shall be used for all materials, equipment and measurements.

A3.2 PROGRAMME OF WORK

The Contractor shall submit to the Architect a detailed programme of the Works within 4 weeks from the acceptance of his Tender showing the intended method, stages and order of work execution in coordination with the building construction programme, together with the duration he estimated for each and every stage of the Works. The programme shall include at least the following: -

(a) Dates for the placement of orders and delivery dates for equipment and materials to Site;

(b) Expected completion dates for builder's work requirements, i.e. when work site needs to be ready;

(c) Dates of commencement and completion of every stage of the Works in line with the building construction programme, i.e. each floor level and/or zone area;

(d) Dates of documents/drawings submissions to relevant Government departments to obtain the necessary approvals;

(e) Dates of expected readiness of documents/drawings from relevant parties for all fire service installations, RFSI and RFSP not carried by the Contractor for consolidated submission to the FSD for comment and approval and for inspection by the FSD;

(f) Dates of requirement of temporary/permanent facilities necessary for testing & commissioning and for completion of the Works, e.g. electricity supply, water and town gas;

(g) Dates of completion, testing and commissioning;

(h) Dates of fire service inspections by the Authorities and the Architect;

(i) Dates of fire alarm direct link application and connection; and

(j) Short term programmes showing the detailed work schedules of coming weeks and months shall also be provided to the Architect. Programmes shall be regularly updated to reflect the actual progress and to meet the Contractor' s obligations under the Contract.

In addition, detailed submission schedules for installation drawings, equipment and testing and commissioning shall be submitted to the Architect for approval. The formats and information to be included in the schedules shall be as required by the Architect.

The Contractor shall allow the time required for obtaining the comments, approval and any re-submission required in his programme.

The Contractor is also responsible for the timely submission for the acceptance by the Architect of other items required in the Contract such as technical literature and material samples.

A3.3 BUILDER'S WORK

All builder's work including pipework openings, holes through building structure or partition walls; trenches, ducts and cutting; and all concrete bases, supports, ducts etc. required for the installation will be carried out as part of the building work by the Building Contractor provided that the Contractor has submitted full details of such requirements within a reasonable time to the Architect for approval, so that due consideration may be given before the Building Contractor commences the building works in accordance with the building programme in the areas concerned. After obtaining the said approval of the Architect, the Contractor is required to mark out at the relevant locations of the Site the exact positions and sizes of all such works and to provide detailed information of such works to the Building Contractor to facilitate him to carry out the builder's works as the works proceed.

All 'cutting-away' and 'making-good' as required to facilitate the Contractor's works will be carried out by the Building Contractor, except for minor provisions required for the fixing of screws, raw plugs, redhead bolts, etc. which shall be carried out by the Contractor. The Contractor shall mark out on Site and/or supply drawings of all 'cutting-away' to the Building Contractor within a reasonable time.

All expenses properly incurred and losses suffered by the Employer as a result of the Contractor's failure to comply with the above requirements are recovered by the Employer from the Contractor.

The Contractor shall ensure that such works are essential for the execution of the Works. In the event that any of such works is proved to be non-essential, unnecessary and/or abortive, the Contractor shall bear the full cost of such works including but not limited to any unnecessary or incorrect cutting-away and making-good, and shall reimburse the Employer for all cost incurred in this connection.

Upon completion of the builder's works by the Building Contractor, the Contractor shall forthwith check and examine that all builder's works so executed have been completed in accordance with his requirements. If at any time it becomes apparent to the Contractor that any builder's works completed by the Building Contractor does not comply with his requirements in any respect whatsoever, the Contractor shall forthwith give notice in writing to the Architect and specify in details the extents and effects of such non-compliance in that notice. The Contractor is deemed to have satisfied with the builder's works after a period of 14 days from the date of completion of the builder's works if the above notice is not served to the Architect within such period. All additional expenditure properly incurred and all losses suffered in this connection by the Employer in having such works re-executed and rectified shall be recoverable by the Employer from the Contractor.

Where any work requires piercing waterproofing layers or structures, the method of installation must have prior approval, in writing, from the Architect. Unless otherwise specified or instructed, the Contractor shall provide all necessary sleeves, puddle flanges, caulking and flashing as appropriate to make these penetrations absolutely watertight.

The Contractor shall ensure their installation is easily accessible for maintenance, and where necessary, the Contractor shall include in the builder's work drawings for approval the requirement of the builder's work for future maintenance facilities. This may include lifting I-beams, anchor eyebolts, access ladders, external working platforms, drain points, water points etc. Where there is a Building Contractor and the builder's work for future maintenance facilities in the builder's work drawing is approved by the Architect, such builder's work will be provided by the Building Contractor.

A3.4 COORDINATION OF CONTRACT WORKS

The Contractor shall coordinate the Works with those works of the Building Contractor and any other contractors and sub-contractors.

The Contractor shall note that the Drawings supplied to him only indicate the approximate locations of the works. He shall make any modification reasonably required of his programme, work sequence and physical deployment of his work to suit the outcome of work coordination or as necessary and ensure that all cleaning, adjustment, test and control points are readily accessible while keeping the number of loops, cross-overs and the like to a minimum.

The Drawings only indicate the size and general layout of the required pipework. The exact position may not be indicated for the purpose of clarity, and pipes are generally shown as separately spaced out from one another as if they were at the same plan level**.**

The Contractor shall relate all horizontal and vertical measurements taken and/or applied, to establish bench marks such as design drawing grid lines, finished floor levels etc. and shall thus establish satisfactory lines and levels for all work.

All works shall be installed to these established lines and levels and the Contractor shall verify all measurements on Site and check the correctness thereof as related to the work.

Primary bench base line, datum level, horizontal reference grid, secondary grid and transferred bench mark on each structural level will be provided by the Building Contractor. The Contractor shall co-ordinate with the Building Contractor to obtain all necessary datum and reference grids prior to their surveys and measurements.

The programme of work shall also be coordinated to the satisfaction of the Architect and adhere to the approved overall construction programme.

Any significant problems encountered during the coordination work, which are beyond the Contractor's control shall promptly be reported to the Architect.

The Contractor shall follow the design intent of the Drawings in planning and carrying out the work and shall cross check with other trades in order to verify the line, level, space and sequence in which the work is to be installed.

If directed by the Architect, the Contractor shall, without extra charge, make reasonable adjustments to the proposed installation drawing layouts as are necessary to prevent conflicts with the work of other trades or for the proper sequence of and execution of work. Where such modifications are of a nature and of such unforeseen complexity that they involve unreasonably extra work not covered by the Contract, they may be covered by variation order to be issued by the Architect wherever such a requirement is justified.

Where there are fire service installations, RFSI and RFSP carried out by others in the same building or project that requires inspection by the FSD, the Contractor shall co-ordinate with the relevant parties, check and confirm the completion and readiness of these installations and provisions for fire service inspection by the FSD. The Contractor shall co-ordinate, obtain the drawings and necessary information from the relevant parties and include all such fire service installations, RFSI and RFSP in the submission to the FSD for comment and approval and for subsequent inspection by the FSD. The Contractor shall report to the Architect the status of such co-ordination and any non-compliance with the requirements of the FSD where found on the works carried out by others.

The Contractor shall co-ordinate with relevant parties, inspect, check and witness the final functional and performance tests on all fire service installations and RFSI carried out by others to identify any non-compliance with the requirements in the FSDCoP, FSD Requirements and Circular Letters, FS_TC and EE_TC. Any works found not complying with the fire service requirements of the FSD shall be rectified when they are included in the Works, or be reported by the Contractor to the Architect when such works are carried out by others, before arranging inspection with the FSD. The Contractor shall co-ordinate with relevant parties to ensure that the final functional tests and performance tests on works by others can be carried out before inspection by the FSD. The Contractor shall co-ordinate and check that all fire service installations, RFSI and RFSP by others to be inspected by the FSD are tested, rectified where necessary, and certified by relevant parties before arranging inspection with the FSD. Upon witnessing the satisfactory completion of all final tests and inspections after rectification of non-conformities related to fire service, the Contractor shall certify such installation by others taking the role as a registered fire services installation contractor for it.

Unless otherwise specified, witnessing and inspection of such works of others by the Contractor shall be limited to those items and aspects required to be inspected by the FSD, required under the FSDCoP, FSD Requirements and Circular Letters, and FS_TC, and as required by the FSD and the Architect.

The electrical works carried out by the Contractor shall be in accordance with the Electricity Ordinance and the Contractor shall provide all necessary document/information in good time required to other Contractor(s) or Sub-contractor(s) for consolidation submission to relevant authority/utility company or maintenance agent of the property for obtaining the electricity supply.

The ventilation works carried out by the Contractor shall be in accordance with the Buildings Ordinance and the Contractor shall provide all necessary document/information in good time required to other Contractor(s) or Sub-contractor(s) for consolidation submission to relevant authority.

A3.5 COOPERATION WITH OTHER CONTRACTORS

The Contractor shall cooperate at all times with the Building Contractor and all other contractors and sub-contractors in order to achieve efficient workflow on Site and to suit Building Contractor’s building programme.

Any significant problems beyond the Contractor’s control shall promptly be reported to the Architect.

A3.6 SITE SUPERVISION AND TRAINING OF EMPLOYER’S STAFF

The Contractor shall keep full time on the Site a competent and technically qualified site supervisor to control, supervise, co-ordinate and manage all his Works on Site. The supervisor shall be vested with suitable powers to receive instructions from the Architect.

The site supervisor shall be technically competent and have adequate site experience for the Works. The Contractor shall also refer to the Particular Specification for the Works for other specific requirements, if any, on site supervision.

Approval by the Architect shall be obtained prior to the posting of the supervisor on Site. The Contractor shall immediately replace any site supervisor whose experience, skill or competency is, in the opinion of the Architect, found to be inadequate for the particular work.

The Contractor shall provide training for the operation and where necessary maintenance of sophisticated equipment. The training shall include all training facilities, material and handouts etc. The Contractor shall submit a training schedule and proposal at least 3 months prior to completion of the Works for the Architect's Approval.

The Contractor shall provide adequate training to the Employer's staff to operate the fire alarm control system and to monitor and to reset/mute alarms in the fire service installation at completion of the Works and before the commencement of the Maintenance Period. The Contractor shall provide adequate training to the Employer's staff on the operation of the fire service installation during fire alarm, fault alarm, warning alarm and other emergency situations as appropriate. The Contractor shall provide contact telephone list as necessary to the Employer's staff.

The Contractor shall provide facilities and training programme to ensure that the Employer's operation and maintenance staff, as available, acquire full knowledge and appreciation of all aspects of the design, day-to-day operation, diagnosis and where necessary, breakdown and routine maintenance, and hence operate and maintain reasonably effectively and efficiently the system/equipment. The Contractor shall provide training materials to ensure that the Employer's operation and maintenance staff, as available, acquire full knowledge of the locations of all the alarms, warning signals, drain valves, and all devices requiring monitoring.

The Contractor shall provide training on the addressable fire alarm system as stipulated in Clause B8.13.

A3.7 SAMPLE BOARD

Within 6 weeks of the acceptance of his Tender and prior to the commencement of installation work, the Contractor shall submit to the Architect for approval in a reasonable time a sample board of essential components proposed to be used in the Contract. However, the Contractor may request the Architect in writing for an extension of time, if 6 weeks are practically insufficient.

Items displayed shall be deemed to be adequate for the Works unless otherwise clearly indicated. Each sample, with clear numbering and labelling, shall be firmly fixed onto a rigid wooden or metal board. A list shall also be affixed on the sample board to show the item description, make and brand, country of origin and locations of installation (if not generally used). Samples rejected by the Architect shall be replaced as soon as possible. Upon approval of all items, the Architect will endorse the list on the sample board and the Contractor shall deliver the board to the site office for reference.

The board shall contain samples of all 'compact' sized materials and accessories to be used in the Works. Written approval of all samples and technical details shall be obtained from the Architect before commencement of any installation work.

In the context of this General Specification the term 'compact' means any item that will fit into a 300 mm cube.

The following items shall be included in the sample board as a minimum:

(a) Pipework, fitting and their support complete with fixing accessories;

(b) Cable and accessories;

(c) Conduit/trunking and accessories including adaptor for flexible conduit;

(d) Fire alarm call point, bell and flashing light;

(e) Sprinkler head complete with escutcheon and adaptor;

(f) Automatic fire alarm detector and remote indication unit;

(g) Flow switch, pressure switch and gauge;

(h) Exit sign;

(i) Emergency lighting;

(j) Duct detector with probe unit;

(k) Fire damper complete with fusible link/electro-thermal link/actuator;

(l) Automatic actuating device for fire shutter;

(m) Indication lamp, switch, push button etc for control panel; and

(n) Gas discharge nozzle for gaseous extinguishing system.

A3.8 ADVICE OF ORDER PLACED

The Contractor shall submit copies of all orders placed for major items of equipment and materials to the Architect for record. Where the country of origin is given in the Contractor's tender offer and submission, documentary proof of orders placed for equipment and materials supplied from relevant countries shall be submitted.

The Contractor shall submit delivery schedule for major items of equipment and materials to the Architect to demonstrate the adherence to the building construction programme.

A3.9 RECORD OF MATERIALS DELIVERY

The Contractor shall inform the representatives of the Architect and invite him for inspection for all materials and equipment delivered to Site. All materials delivered to Site shall be accurately listed and recorded in the site record books maintained by the representatives of the Architect on Site.

Materials and equipment delivered to Site and paid for in interim payment shall be the Employer's property. Such materials and equipment shall not be removed from Site without the approval of the Architect in writing and appropriate deduction shall be made in the next interim payment in accordance with the Contract.

Where the Building Contractor is in overall control of the Site, the Building Contractor may also be required to record details of all incoming/outgoing materials. In this case, the Contractor shall comply with the Building Contractor's arrangements.

A3.10 PROTECTION OF MATERIALS AND EQUIPMENT

Unless the responsibility is clearly defined in the Contract that the protection on Site for delivered equipment, materials and installation is solely by other contractors, the Contractor shall be responsible for the safe custody of all materials and equipment as stored or installed by him until finally inspected, tested and accepted. In addition, the Contractor shall protect all work against theft, fire, damage or inclement weather and carefully store all materials and equipment received on Site but not yet installed in a safe and secure place unless otherwise specified.

All cases of theft and fire must immediately be reported to the police, the Building Contractor, the Architect and the Architect's representatives on Site with full details.

Where necessary the Contractor shall provide lockable steel container or other equally secure enclosures placed within a securely fenced-in compound provided by the Building Contractor on Site for the storage of materials and equipment.

The Contractor shall co-ordinate and arrange with the Building Contractor who shall provide clean, reasonably finished and lockable secure accommodation for the storage of sensitive and/or expensive items before installation.

If there is no Building Contractor, all the storage facilities and spaces shall be provided by the Contractor.

A3.11 REGISTERED PERSONNEL

If the Contractor himself is not a registered contractor under the relevant Ordinance, he shall employ registered contractors and personnel to carry out the Works under the Fire Service Installation as follows: -

(a) Fire service installation works - Fire service installation contractor(s) and personnel registered under Fire Services Ordinance, Cap 95, Laws of the Hong Kong Special Administrative Region in the class(es) relevant to the type(s) of installation concerned;

(b) Electrical works – Electrical contractor(s) and worker(s) registered under Electricity Ordinance, Cap 406, Laws of the Hong Kong Special Administrative Region in the grade(s) relevant to the type(s) of installation concerned;

(c) Ventilation works – Ventilation contractor(s) registered under the Buildings Ordinance, Cap 123, Laws of the Hong Kong Special Administrative Region;

(d) Water works – Licensed plumber(s) registered under the Waterworks Ordinance, Cap 102, Laws of the Hong Kong Special Administrative Region.

SECTION A4

DRAWINGS AND MANUALS

A4.1 STANDARD DRAWINGS

There are standard abbreviations, symbols and standard drawings prepared by BSB to show details of the common standard installations. The Contractor shall refer to these standards and drawings whenever such are mentioned or specified in the Drawings or the Particular Specification for the Works. The same standards shall also be used in the Contractor's "as-built" drawings, etc., whenever applicable.

Where the Employer's latest Guide Drawings & Details for pipework supports and brackets, expansion joints and anchor points are issued with the specific Contract Documents or have previously been issued to Approved Contractors for general application on the Employer's projects, these standard details shall be followed 'In-Principle' but adjusted as to the detail in order to suit the particular circumstances. Such adjustments shall be indicated on the Contractor's own Installation/Shop Drawing Submissions and be approved by the Architect before work commences.

A4.2 DRAWINGS IN ELECTRONIC FORMAT

The Contractor shall provide drawings in electronic format as required in the following clauses. These drawings shall conform to the latest version of CAD Standard of Works Projects (CSWP) as posted in the web site of the Works Branch, Development Bureau and in accordance with the latest version of CAD Manual for Architectural Services Department Projects. Should any technical conflict between the CSWP and the CAD Manual arise, the CSWP shall take precedence.

A4.3 INSTALLATION DRAWINGS

A4.3.1 Drawing Submission Schedule

The Contractor shall submit a detailed installation drawing submission schedule and programme to the Architect. The Contractor shall allow reasonable time in the programme for vetting of the installation drawings by the Architect and for drawing resubmissions as necessary.

The Contractor shall submit to the Architect a comprehensive "Submission Schedule" of installation drawings and builder's work drawings within 2 weeks after the acceptance of Tender, taking into account of the overall programme of the Works including any Specialist Works and works by the utility undertakings. No equipment shall be delivered to the Site and no work shall be executed until the installation drawings have been approved by the Architect. The Contractor shall ensure that installation drawings and builder's work drawings are progressively submitted in accordance with the approved "Submission Schedule".

The Contractor shall provide at least 6 hard copies and one electronic copy, unless otherwise specified in the Contract, of the approved installation drawings to the Architect for distribution.

A4.3.2 Size of Installation Drawings

Drawings submitted by the Contractor shall only be of standard sizes from A0 to A4 or B1 size as stipulated in ISO 5457:1999.

A4.3.3 Contents of Installation Drawings

The Contractor shall ensure all installation drawings are accurate representation of the Works, before submitting them to the Architect. All installation drawings shall be fully dimensioned and suitably scaled showing construction, sizes, weights, arrangements, operating clearances and performance characteristics.

Installation drawings including manufacturer's shop drawings shall be prepared and submitted to the Architect for perusal by the Contractor in sequence with the construction programme. They shall contain plan layouts, sectional drawings (elevations and plans), vertical plumbing line diagrams, schematic wiring diagrams, installation details, schematic air-side diagram for ventilation/air conditioning control system etc. and shall show the following particulars: -

(a) Service routings and levels relative to the structure and other services;

(b) Plant and equipment locations with dimensions and weights;

(c) Service joints, supports and fixing details together with their locations;

(d) Maintenance accesses, facilities and all necessary details relating to the proper operation and maintenance of the systems;

(e) Calculation and data for gaseous extinguishing system, drencher system and other fire service installations;

(f) Method of control in ventilation/air-conditioning control system; and

(g) Location and type of interfacing with other services for ventilation/air conditioning control system, fireman's lift control and audio/visual advisory system.

The drawings shall include all design accessories and shall be drawn to match the materials and equipment supplied by the Contractor. Drawings showing details in spatial zones shall be prepared subsequent to proper co-ordination with the Building Contractor and other trades on Site.

The Contractor shall furnish the following information for the equipment listed in the Particular Specification together with their drawing submission: -

(a) Name of manufacturer or brand name, country of manufacture, model number and make, and full technical details, of equipment and materials offered;

(b) Voltage of operation and current consumption, for electrical and fire alarm equipment and those for automatic heat, smoke and other types of detectors, (a) under normal conditions, and (b) under alarm conditions;

(c) Type of wiring for alarm circuits;

(d) Evidence, or a signed statement, to the effect that items of equipment and materials requiring the approval of the FSD are so approved;

(e) Copies of approval documents showing compliance with the specified standards of the major items of offered equipment and materials issued by the British Standards Institution, FM, UL, LPCB or by an internationally recognized standard body or testing authority;

(f) Illustrated technical brochures in English or Chinese for the offered equipment and materials and their installation requirements; and

(g) Technical details for engineered systems and pre-engineered systems.

Where design is included in the Works, the Contractor shall also submit design drawings for approval. All design drawings shall be checked and endorsed by Registered Professional Engineer or approved personnel as specified in Clause A1.5 prior to the submission. Unless otherwise specified or approved by the Architect, the Contractor shall submit to the Architect for approval 6 copies of design drawings showing all details.

A4.3.4 Builder's Work Drawings

Unless otherwise approved by the Architect, the Contractor shall submit to the Architect in accordance with the approved "Submission Schedule", 6 copies of drawings showing details of all builder's work required e.g. the weight and the load on each support of equipment. Such drawings shall clearly indicate the details and positions of all openings, trenches, ducts and cutting required and construction details for plinths and equipment bases.

A4.3.5 Manufacturer's Shop Drawings

The manufacturer's shop drawings are drawings for equipment or plant to be manufactured by a specialist-manufacturing supplier in their own workshops and places away from the Site.

The drawings shall show detailed construction, principal dimensions, weights and clearances for maintenance, etc. Immediately after placing of any order or at any event within 4 weeks unless otherwise approved in writing by the Architect, the Contractor shall forward to the Architect for comment, 4 copies of manufacturer's shop drawings, indicating detailed construction, principal dimensions and weights, clearances for withdrawals and/or cleaning, etc. No work shall proceed on or off Site unless drawings requiring approval are so approved in writing by the Architect.

A4.3.6 Drawings for Submission to Other Authority (FSD / Gas Office / EMSD / WSD etc)

Installation drawings showing the hydraulic systems connected directly to the water mains supply shall be submitted to the Water Supplies Department for approval. The Contractor shall submit the hydraulic system drawings approved by the Architect to the Water Supplies Department before commencement of work. The Contractor shall also complete the relevant water work standard application forms and submit the same to the Water Supplies Department after obtaining endorsement on the form by the Client or Architect.

4 sets of the preliminary installation drawings shall be submitted to the Architect who will then check, endorse and return 2 sets to the Contractor for onward submission to the FSD for perusal. Works can only be commenced upon receipt of a set of drawings chopped/recorded by the FSD and written approval from the Architect. 4 sets of all such approved drawings and 3 sets of electronic copies in CD-ROM shall then be submitted to the Architect. If there are changes in the course of installation, the Contractor shall submit the updated installation drawings which shall reflect the as-built installation to the FSD for perusal prior to the FSD inspection.

The Contractor shall also keep on Site one set of updated approved installation drawings available for inspection by the Architect at all times. The drawings shall be marked up with any modifications made during installation and testing and commissioning. The drawings shall be kept in the Architect's Representative's office on Site where it is required by the Architect.

A4.4 AS-BUILT DRAWINGS

A4.4.1 Submission of As–built Drawings

The Contractor shall submit 3 sets of the first draft prints of as-built drawings within 28 days of the issuance of the certification of completion to the Architect for checking. The Architect after checking the above draft prints shall return one set of the marked up copies of these as-built drawings to the Contractor within 42 days from the date of submission of the Contractor's draft prints with comments. The Contractor shall within a further 28 days from the date of receiving the Architect's comments on the draft as-built drawings re-submit to the Architect for his approval another 3 sets of the second draft prints of as-built drawings with the Architect's comments incorporated. This process of submission and approval shall continue until the final approval of the Architect on these as-built drawing is obtained.

Unless otherwise specified, the final approved as-built drawings shall be in one set of hard copy and 3 sets of electronic copies. These shall be submitted within 21 days from the date of final approval. Each electronic copy shall be in the form of CD-ROM, labelled, with cross reference to a printed list of files explaining the contents and purpose of each file and supplied in sturdy plastic containers.

The detailed requirements and the media of as-built drawings set out in the Preliminaries of the Bills of Quantities or the Specification Preliminaries shall be followed as appropriate.

A4.4.2 Size of As-built Drawings

As-built drawings shall only be of standard sizes of A0, A1 or B1 size as stipulated in ISO 5457:1999.

A4.4.3 Content of As-built Drawings

The Contractor shall ensure all as-built drawings are accurate representation of the Works, before submitting them to the Architect. The as-built drawings required to be provided by the Contractor for various types of BS/E&M installations shall include, but not limited to the followings: -

(a) Building services layout plans such as ducting arrangement, trunking arrangement, piping arrangement, etc.;

(b) System schematic diagrams, control diagrams and wiring diagrams;

(c) Concealed work layout plan such as concealed conduit routing, etc.;

(d) Installation details and assembly drawings such as LV cubicle switchboard layout, motor control cubicle layout, etc.; and

(e) All approved installation Drawings.

A4.4.4 Framed Drawings

The Contractor shall submit as-built main schematic drawings for various fire service installations, in non-fading prints, mounted in glass-frames and fix in all fire service pump rooms and in the fire control centre where the fire alarm control and indicating panel/fire control centre is located. Glazing shall be polished plate of not less than 6 mm thickness mounted in natural finish, extruded and anodised aluminium frames with the prints mounted on acid free mounting board and the whole backed with marine grade plywood not less than 8 mm thick or as approved.

In addition to the above, the contractor shall supply one full bound set of as-built drawings in print and store them in a metal container provided by the Contractor and approved by the Architect in the fire control centre or in a location in the building to be determined by the Architect. The container shall be properly labelled and shall be of appropriate size to contain the folded drawings.

A4.5 OPERATION AND MAINTENANCE (O&M) MANUAL AND USER MANUAL

A4.5.1 General

The Contractor shall provide two types of manuals to the Architect with all changes made to the installation during the course of the Contract suitably incorporated.

The O&M Manuals are for use by the maintenance agent of the completed installation. It shall contain detailed technical information covering both operation and maintenance aspects of the installation.

The User Manual is to give the users of the completed installation an overview of the essential information of the installation. The contents of the manual should be concise and succinct for ease of comprehension by people with a non-technical background.

A4.5.2 Checking and Approval

The Contractor shall submit 3 sets of the first draft of O&M Manuals and User Manuals together with a list of recommended spare parts for one year's operation and a list of special tools, both complete with prices to the Architect for comment at least 56 calendar days prior to the testing and commissioning of the plant and equipment.

The Architect will check the drafts and return them to the Contractor within 42 calendar days from the date of submission with comments necessary for a final and approved set of document. The Contractor shall then make all necessary amendments to the documents and resubmit them to the Architect within 21 days from the date of receipt of documents.

The Contractor shall submit 3 sets of hard copies (one of which shall be the original) and one set of electronic copy of the final approved O&M Manual and User Manual plus 2 additional copies of the key data summary sheets in separate CD-ROM using approved software format within 21 days from the date of approval by the Architect.

Each electronic copy shall be in the form of CD-ROM, labelled, with cross reference to a printed list of files explaining the contents and purpose of each file and supplied in sturdy plastic containers.

A4.5.3 Structure and Content of O&M Manuals

The detailed requirements, structure and contents of the O&M Manual shall be as specified in elsewhere in the Contract and shall include the following information under separate sections where appropriate: -

(a) Project Information

This shall include: -

Project title, site address, contract no., contract title, contractor/sub-contractor name, address, contact persons and their telephone/fax nos., contract commencement date, substantial completion date and end date of Maintenance Period.

(b) The certified copy of the final design report for Performance Based Fire Engineering System if applicable.

(c) System Description

(i) Type(s) of system(s) and equipment installed;

(ii) Design criteria, design data and parameters;

(iii) Locations of the system and major equipment, and what they serve;

(iv) Description of operation and functions of the system and equipment;

(v) General operating conditions, expected performance and energy and resources consumption where applicable.

(d) List of Installed Equipment

(i) Schedule of all items of equipment and plant stating the location, name, model no., manufacturer's serial or reference no., manufacturer's design duties and data;

(ii) A key data summary sheet for all the installed equipment and systems as a maintenance inventory record. Details and format of the key data summary sheet shall be submitted to the Architect for approval and shall include key data such as design area, building type, type of equipment, rating and capacity of equipment, brand name and model number, code (barcode) of equipment where provided, construction material of the equipment, location of equipment/installation, number of equipment such as number of sprinklers etc, length of pipes, key dimensions and thickness of equipment, agents in equipment, cost data and other key data necessary for facility management, future design reference and inventory record.

(e) Spare Parts and Special Tools Lists

(i) List of Spare Parts supplied by Contractors:

Item descriptions, supplied quantities, model nos., manufacturer's serial or reference nos. and storage locations;

(ii) Recommended Spare Parts List and Special Tools List: Manufacturers'/suppliers' recommendations for spare parts and special tools with item description, unit rate, recommended stock quantities as well as the agents for the spare parts and special tools.

(f) Manufacturers' Certificates/Guarantees

(i) Manufacturers' certificates such as factory test certificate, laboratory test reports, guarantees and any others where required for the equipment and plants etc.

(ii) Certified True copy or Originals of submitted/endorsed/approved Statutory Inspection Certificate for various installations, including: -

- Electrical installations (e.g. Work Completion Certificate - Form WR1 or Form WR1a);

- Fire service installations (e.g. Fire Service Certificate - Form FS172, Form 314, Form 501, Form 251, Form 314a etc.);

- Installations work for Dangerous Goods Stores Licence Application; and

- Others equipment such as surveyor's test certificates for high-pressure vessel, surveyor's load certificates for electrical operated roller shutters, lifting devices/appliances, etc.

(g) Safety Precautions for Operation and Maintenance

State, where applicable, hazard warnings and safety precautions of which the operation and maintenance staff need to be aware: -

(i) mandatory requirements relating to safety;

(ii) known hazards against which protection measures shall be taken; and

(iii) known features or operational characteristics of the installed equipment or systems which may cause hazard and the related safety precautions.

(h) Operation Instructions

Instructions for the safe and efficient operation, under both normal and emergency conditions, of the installed system which shall comprise: -

(i) an outline of the operating mode;

(ii) control logic and data (sequence, effect, limits of capability, modes and set points);

(iii) procedures and sequences for start-up and shut-down;

(iv) interlocks between equipment/system;

(v) calling on of stand-by equipment;

(vi) precautions necessary to overcome known hazards;

(vii) means by which any potentially hazardous equipment can be made safe;

(viii) estimation of energy consumption and energy costs;

(ix) forms for recording plant running hours, energy consumption and energy costs; and

(x) operating data such as running current, operating pressure, operating flow rates etc.

(i) Maintenance

(i) Maintenance instructions

Provide manufacturers' and the Contractor's recommendations and instructions for the maintenance of the installed equipment. Clear distinction should be made between planned tasks (preventive maintenance) and fault-repair tasks (corrective maintenance). Instructions shall be given on each of the following, as appropriate: -

- nature of deterioration, and the defects to be looked for;

- isolation and return to service of plant and equipment;

- dismantling and reassembly;

- replacement of components and assemblies;

- dealing with hazards which may arise during maintenance;

- adjustments, calibration and testing;

- special tools, test equipment and ancillary services.

A list of the expiry dates for time limited certificates of installation works such as testing certificates of luminaires suitable for use in hazardous environment for Dangerous Goods Stores.

(ii) Maintenance schedules

Proposed maintenance schedules for all the preventive maintenance tasks identified above. The schedules shall be based on both manufacturers' recommendations and other authoritative sources (e.g. statutory or mandatory requirements) and should include : -

- routine servicing;
- inspections;
- tests and examinations;
- adjustments;
- calibration;
- overhaul.

The frequency of each task may be expressed as specific time intervals, running hours or number of completed operations as appropriate. Collectively, the schedules will form a complete maintenance cycle, repeated throughout the whole working life of the installation.

(j) Drawing Lists

(i) A complete list of as-built drawings identified with drawing number/reference;

(ii) A complete list of manufacturers' shop drawings with drawing number/reference, where applicable; and

(iii) A brief description of CD-ROM for these drawings.

(k) Technical Literatures

A complete set of manufacturers' literatures for all the plant and equipment installed in the system. The contents of these literatures shall cover the following areas where applicable: -

(i) description of equipment with model numbers highlighted;

(ii) performance - behavioural characteristics of the equipment;

(iii) applications - suitability for use;

(iv) factory/laboratory test reports, detailed drawings, circuit diagrams;

(v) methods of operation and control;

(vi) operation instructions;

(vii) cleaning and maintenance requirements;

(viii) plants, materials and space required for maintenance;

(ix) protective measures and safety precautions for operation and maintenance; and

(x) part lists.

(l) Contact addresses and telephone numbers of suppliers of major equipment.

A4.5.4 Structure and Content of User Manual

The detailed requirements, structure and contents of the User Manual shall include, where applicable, the following information: -

(a) Project Information

This shall include:

Project title, site address, contract no., contract title, contract commencement date, substantial completion date and end date of Maintenance Period.

(b) System Description

(i) Type(s) of system(s) and equipment installed, and their purposes;

(ii) Locations of major plant rooms and riser ducts;

(iii) Brief description of the operation and functions of the systems and equipment;

(iv) Listing of set points which can be adjusted by the user to suit their operation needs.

(c) Schedule of Major Plant Rooms and Installed Equipment

(i) Schedule of major plant rooms and riser ducts including their locations;

(ii) Schedule of major equipment and plants including their locations and serving areas.

(d) Safety Precautions for Operation

Any safety precautions and warnings signals that the users shall be aware of in the daily operation of the various systems and equipment in the installation including: -

(i) mandatory requirements relating to safety;

(ii) features or operational characteristics of the installed systems or equipment which may cause hazard and the related safety precautions;

(iii) protective measures and safety precautions for operation; and

(iv) list of warning signals and the related meanings that the user shall be aware of and the actions to be taken.

(e) Operation Instructions

Instructions for the safe and efficient operation, under both normal and emergency conditions, of the installed system which shall comprise: -

(i) an outline of the operating mode;

(ii) step by step operation instructions for systems and equipment that are to be operated by the user, including at least procedures for start-up and shut-down;

(iii) means by which any potentially hazardous situation can be made safe; and

(iv) cleaning and basic maintenance procedures.

(f) List of Statutory Periodic Inspections and Tests

A schedule of periodic inspections and tests that owner and/or user of the installation have to arrange to achieve compliance with the requirements stipulated in the relevant Laws of the Hong Kong. The frequency of such inspections and tests shall be expressed in specific time intervals.

(g) Drawings

A set of selected as-built drawings which shall be able to illustrate to the user the general layout of the completed installation.

(h) Photographs

A set of photographs with suitable captions to illustrate to the user the appearance and locations of the devices which requires their setting and operation.

A4.5.5 Presentation

All manuals shall be written in English, unless otherwise specified. The text of descriptive parts shall be kept concise while at the same time ensure completeness. Diagrammatic materials shall also be supported by comprehensive descriptions.

The manuals shall comprise A4 loose-leaf, where necessary, A3 size folded loose-leaf. The loose-leaves shall be of good quality paper that is sufficiently opaque to avoid "show-through". Unless otherwise specified in the Contract, the manuals shall be bound in durable loose-leaf four ring binders with hard covers. The manuals shall have labels or lettering on the front cover and spine. The Architect's approval shall be obtained on this at the draft manual stage. The electronic copy of manuals including the technical literatures, shall be in PDF format readable by Acrobat Reader Freeware.

A4.6 INTELLECTUAL PROPERTY RIGHTS

The Government shall become the absolute and exclusive owner of the Operation and Maintenance Manuals and the User Manual and all intellectual property rights subsisting therein free from all encumbrances.

In the event that the beneficial ownership of any intellectual property rights subsisting in the above Manuals are vested in anyone other than the Contractor, the Contactor shall procure that the beneficial owner shall grant to the Employer a transferable, non-exclusive, royalty-free and irrevocable licence (carrying the right to grant sub-licences) to utilize the intellectual property rights in the manuals for the purposes contemplated in the Contract. For the avoidance of doubt such purposes shall, but not limited to, include providing free coping of the material in the manuals by any subsequent owner or user of the installation, and/or any party responsible for the operation and maintenance of the installation in connection with any subsequent alteration, extension, operation and maintenance of the installation.

A4.7 ADDITIONAL REQUIREMENTS FOR ADDRESSABLE SYSTEM

Where addressable fire alarm, detection, control or similar system is supplied and installed, the Operation and Maintenance Manuals and the as-built drawings submitted shall include, but not limited to, the following details, in addition to all requirements as mentioned above:

(a) As-built interconnecting field wiring diagrams, or wiring lists, of the complete field installed system with complete, properly identified, ordering number of each device and system component;

(b) Operator manual with step-by-step procedures. The manual shall be indexed, and shall have a separate tabled section for each operator function;

(c) Operator's/Programmer's Manual with complete description of all programming functions, including sample written programs, related to operation;

(d) Layout plan showing the fire control panel, field device locations and field device point list;

(e) Schedule of set points of the system; and

(f) Complete description of the sequence of operation of the fire alarm control system with flow charts and decision trees.

The Contractor shall provide all the keys and passwords required for accessing all parts of the addressable system without restriction.

In addition, the User Manuals submitted shall include, but not limited to, the following details, in addition to all requirements as mentioned above:

(a) Operator manual with step-by-step procedures. The manual shall be indexed, and shall have a separate tabled section for each operator function;

(b) Layout plan showing the fire control panel, field device locations and field device point list;

(c) Schedule of set points of the system; and

(d) Complete description of the sequence of operation of the fire alarm control system with flow charts and decision trees.

A4.8 CHECKING BEFORE SUBMISSION

All installation drawings, builder's works drawings, manufacturers' shop drawings, design drawings, as-built drawings, O&M manuals and User manuals shall be checked and endorsed by a Registered Professional Engineer in Hong Kong under CAP 409 in approved disciplines (or person having equivalent approved professional qualification) specialised and experienced in fire service installation employed by the Contractor and approved by the Architect before submission. For minor fire service installation, they can be checked and endorsed by a qualified and experienced staff of the Contractor when approved by the Architect, following similar requirements in Clause A1.5.

SECTION A5

GENERAL REQUIREMENTS OF THE WORKS

A5.1 GENERAL REQUIREMENTS ON MATERIALS, EQUIPMENT AND INSTALLATION STANDARDS

A5.1.1 Material and Equipment Standards

All materials, equipment and installation work shall be carried out by adoption of the best available quality materials and workmanship and shall, where applicable, comply with the latest edition of the appropriate standards and/or codes of practice issued by the relevant recognised international institutes, standard bodies and authorities and as specified in the Specification. This requirement shall be deemed to include all amendments to these standards and codes up to the date of tendering.

A5.1.2 Compatibility of Materials and Equipment

Where different components of equipment are interconnected to form a complete system, their characteristics of performance and capacities shall be matched in order to ensure efficient, economical, safe and sound operation of the complete system.

A5.1.3 Equipment Catalogues and Manufacturer's Specifications

Equipment catalogue and manufacturer's specification related to the proposed items of equipment shall be specific and shall include all information necessary for the Architect to ascertain that the equipment complies with this General Specification, the Particular Specification and Drawings. Sales catalogue of a general nature are not acceptable. Unless otherwise approved by the Architect, all data and catalogues submitted shall be in SI units i.e. mm, m, kPa, m/s, Hz, kW, l/s etc.

The Contractor shall submit catalogues and manufacturer's specification of the proposed equipment for the examination and approval of the Architect in writing before any equipment is ordered.

A5.1.4 Manufacturers' Technical Support in Hong Kong

All equipment requiring approval by the relevant authorities including the WSD, FSD or by the product certification bodies stipulated in FSD Circular Letters shall be supplied through authorised agencies/sub-agencies of the manufacturers in Hong Kong or through the Hong Kong offices of the manufacturers. The Contractor may be required to produce such authorisation from the authorised suppliers when required. These local agencies/sub-agencies or offices shall have adequate technical staff to provide pre-sale and after-sale services to the Contractor and to make submission to the WSD and FSD to prove the compliance of the equipment with the WSD's requirements and the FSD Requirements and Circular Letters and to take the responsibility of maintaining the validity of the submission by observing all the conditions and requirements in the approval by the WSD and FSD.

A5.1.5 Selection of Equipment

Selection of equipment shall be based on the Particular Specification, the technical data contained in the Drawings for a particular installation, and this General Specification.

Where items of equipment are interconnected to form an integral part of the complete fire service installation, their characteristics of performance and capacities shall be so matched as to give safe, reliable, efficient and economical operation of the complete fire service installation.

A5.1.6 Service Conditions

The following service conditions shall apply unless otherwise specified

(a) Climate: Hong Kong (tropical)

(b) Ambient temperature:
Peak -5°C to +40°C (continuously 4 hours)
Average 0°C to +35°C (over 24 hours)

(c) Altitude: up to 2000 m above sea level

(d) Relative humidity: 99% maximum non-condensing

A5.1.7 Voltage Covered by this General Specification

Unless otherwise specified, all apparatus, equipment, materials and wiring shall be suitable for use with a 3-phase and neutral, 4-wire, 380/220V ±6%, 50 Hz. ±2%.

A5.1.8 Tradesmen and Supervision

All tradesmen must be experienced in the trade and the work carried out shall be consistent with good practice in Hong Kong and to the satisfaction of the Architect. The Contractor shall employ not less than one competent foreman on Site for each trade during installation. All trade foremen shall be registered tradesmen of the relevant trade.

In addition to the full time site supervision specified in Clause A3.6, the Contractor shall employ for the overall control and supervision of the Works, one or more qualified and competent supervising engineers approved by the Architect. The qualification and experience of the supervising engineers shall be submitted to the Architect for approval. The Contractor shall ensure that approval by the Architect is obtained prior to any installation work.

The Contractor shall immediately replace any trade foreman or supervising engineer whose experience, skill or competency is, in the opinion of the Architect, found to be inadequate for the particular work.

A5.1.9 Tools and Instruments

Proper tools shall be used for the works. Adequate and accurate testing/measuring instruments shall be used to demonstrate compliance of the installations with the relevant specifications and regulations. The Architect has the right to stop any work in which the correct tools and/or instruments are not used.

Instruments used for acceptance tests shall be calibrated at an interval time of one year unless otherwise as required in the Contract for a particular project.

A5.1.10 Workmanship Standard

The installation works shall be in line with the good practice accepted by the local industry and verified by the testing and commissioning results.

The installation works shall be in compliance with this General Specification, Particular Specification and Drawings of a particular project.

The installation shall be in compliance with the statutory requirements in respect of labour safety, fire safety, structural safety, electrical safety and environmental protection.

Apart from those requirements as stipulated in this General Specification and other statutory requirements, due care shall be taken to secure public safety and health both during the execution of the works and in the selection of equipment and materials.

A5.1.11 Warning Notice

Warning notices shall be provided as required by the Electricity Ordinance, Occupational Safety and Health Ordinance, the Code of Practice for the Electricity (Wiring) Regulations and other statutory regulations. In addition, warning notices shall be provided for electrical equipment complying with General Electrical Specification.

A5.1.12 Guard and Railing for Moving or Rotating Parts of Equipment

All moving or rotating parts of equipment shall be provided with an approved guard and railing complying with the Factories & Industrial Undertakings (Guarding an Operation of Machinery) Regulations, published by the Labour Department, together with any amendments made thereto.

Guards shall be rigid and of substantial construction and shall consist of heavy mild steel angle frames, hinged and latched with either heavy hot dipped galvanised mild steel wire crimped mesh securely fastened to frames or hot dipped galvanised sheet metal of 1.2 mm minimum thickness. All apertures shall be such that finger access to dangerous part is not possible. All sections shall be bolted or riveted. Railings shall be made of 32 mm dia. galvanised mild steel pipe and railing fittings.

During the execution of work, the Contractor shall ensure that all moving parts are adequately guarded by temporary guards. Adequate temporary guard railings etc. around dangerous floor/wall openings in the vicinity of any work for the protection shall be provided. Where there is a Building Contractor, for the safety of workers, guard railings etc. are to be provided by the Building Contractor, but in case they are not provided, the Contractor shall immediately report the matter to the Architect.

A5.1.13 Space for Plant

The Contractor shall ensure that all plants, material and equipment supplied by him can be accommodated and installed within the spaces as generally shown on the Drawings with adequate access and space for maintenance of all items supplied.

A5.1.14 Quality Assurance Standards

All materials and equipment shall be manufactured by factories with acceptable quality assurance procedures. Factories having ISO 9001:2000 certifications are deemed to have acceptable quality assurance procedures. Other similar quality assurance standards may be accepted by the Architect on their individual merits. Details of such other quality assurance standards shall be submitted with the equipment submission.

A5.2 GENERAL DESIGN REQUIREMENTS

All fire service installations, materials, equipment and systems provided by the Contractor shall meet with the following design objectives: -

(a) Comply with the statutory requirements;
(b) Be effective in controlling/suppressing/detecting fire and smoke;
(c) Provide life safety protection for people evacuation and during fire fighting and rescue operation;
(d) Allow and provide adequate maintenance/overhaul facilities and accesses;
(e) Facilitate operation and alarm monitoring by the users;
(f) Provide a reliable system with a reasonably long operating life;
(g) Reduce the number of faults, false fire alarms, unwanted fire alarm, malfunctioning and inaccuracies of the installation requiring attention;
(h) Allow easy monitoring of system performance and equipment status at all times;
(i) Minimize future maintenance and replacement of parts;
(j) Allow adequate standby and spare facilities to cater for the failure of any part of the installation;
(k) Achieve cost effectiveness in term of life cycle costing with low operation and maintenance cost;
(l) Select and use equipment with optimum performance and with reasonably good energy efficiency;
(m) Reduce noise, vibration and other nuisances to the occupants and neighbours;
(n) Comply with all the safety requirements in future operation and maintenance with particular attention on the occupational safety and health of the workers;
(o) Use durable materials as well as equipment having a steady and reliable supply of parts and spares;
(p) Be aesthetically acceptable for all installations in exposed positions;
(q) Minimise the environmental impact and social effect as appropriate; and
(r) Be flexible to cater for future modification and expansion as appropriate.

Where design is included in the Works and/or design development is specified, the Contractor shall submit documentary evidence and demonstrate to the satisfaction and approval of the Architect that all the above design objectives as relevant are satisfied and complied with reasonably satisfactory solution. Where selection of the brand and model of equipment and material is done by the Contractor, the Contractor shall ensure and may be required to demonstrate to the satisfaction of the Architect that the design, configuration and installation details of equipment and material so selected shall meet with all the relevant design objectives as necessary. The Contractor shall provide design, equipment and material that can meet with all the design objectives as relevant and necessary and not only part of them.

A5.3 GENERAL REQUIREMENTS ON OPERATION AND MAINTENANCE PROVISIONS

All fire service equipment shall be provided with facilities, permanent accesses and sundries for its proper operation, maintenance, inspection, repair, overhaul, testing and servicing after installation. Fire service equipment without consideration of the maintenance and related provisions to the satisfaction of the Architect shall not be accepted.

The Contractor shall provide and allow in the equipment installation adequate facilities for future inspection, monitoring, operation, maintenance, testing, overhaul and replacement. Such facilities shall be built-in during equipment installation. All heavy equipment shall be provided with lifting eyebolt or the like for lifting. All equipment that has a limited operating life shall be accessible and shall be easily removed for maintenance or replacement. Adequate and safe access shall be provided to all parts of the equipment. Adequate special tools shall be provided where necessary. The Contractor shall ensure that access to the plant and equipment is adequate to allow for its removal and/or ultimate replacement. Where this is considered not possible or necessary, the Architect shall be consulted for alternative arrangements in the plant room.

The Contractor shall submit and use equipment that has a reliable and steady supply of spares and parts. The installation and equipment shall be provided with adequate gauges, meters, measuring devices and monitoring facilities for indicating all the essential or necessary parameters for quick inspection and monitoring. All such measuring and monitoring facilities shall be deemed to include in the Works whether they are shown in the Drawings or not. Where necessary measuring and monitoring facilities are found missing or not provided during testing and commissioning stage or in the Maintenance Period, the Contractor shall make such alterations or additions as in the opinion of the Architect as necessary to remedy such non-compliance at the Contractor's own expense. No approval given by the Architect of the drawings and material submission shall absolve the Contractor from liability for this aspect.

Warning notices, operating instructions and working/maintenance instructions shall be provided as necessary adjacent to or near to the equipment. Adequate protective guards shall be provided.

Adequate facilities shall be allowed in the installation for carrying out tests during future inspection and maintenance of equipment. Drains shall be connected to the nearest drain points for carrying out future water flow test for flow switch during routine maintenance.

PART B - FIRE SERVICE INSTALLATION

SECTION B1

PIPEWORK, VALVES AND FITTINGS

B1.1 STEEL PIPES AND FITTINGS FOR EXPOSED PIPEWORK

Pipes and fittings shall be designed to withstand at least 2 times of the working pressure and be tested to withstand at least 1.5 times of the working pressure. Working pressure is the maximum pressure anticipated during the working or operational period. In case a more stringent requirement is specified under the technical standards, rules and codes for individual fire service installation, the requirement whichever is more stringent shall be followed.

For operation at working pressure on or below 1600 kPa, pipes up to and including 150 mm diameter shall be galvanised mild steel of at least medium grade to BS EN 10255:2004 or ISO 65:1981 for screwing to BS EN 10226-1: 2004 or ISO 7-1:1994 pipe threads. Fittings shall be to BS EN 10241:2000.

For operation at working pressure on or below 1600 kPa, pipes and fittings above 150 mm diameter shall be ductile iron to BS EN 545:2002 Class K12 cold bitumen coated externally and internally to BS 3416:1991 Type II or better materials approved by the Architect.

For operation at working pressure above 1600 kPa, pipes on or below 150 mm diameter shall be at least galvanised mild steel pipe of heavy grade to BS EN 10255:2004 or ISO 65:1981, or better materials approved by the Architect to suit the high-pressure requirement.

For operation at working pressure above 1600 kPa, pipes above 150 mm diameter shall be at least carbon steel of ERW 320 to BS3601 or better materials approved by the Architect to suit the high-pressure requirement and shall have dimensions to BS 3600. All fittings shall be butt-welding type carbon steel for pressure purposes to BS EN 10253-1: 1999.

For high-rise building or high-pressure system with working pressure above 1600 kPa, pipes and fittings shall be of higher pressure rating to suit the worst operating conditions.

Selection of pressure number PN or pressure class of fittings, joints, and accessories shall be based on the weakest component of the fittings, joints and accessories such as seating, etc to stand for the required test pressure (at least 1.5 times of working pressure). Details shall be submitted to the Architect for approval.

Where galvanised steel pipe is specified, the zinc content shall be not less than 98.5% by weight of zinc. The pipe shall have a complete uniformly adherent coating of zinc.

B1.2 COPPER PIPEWORK

Where copper pipe is specified, the copper pipe shall comprise seamless hard drawn copper tubes manufactured to BS EN 1057 and of appropriate gauge to suit the working pressure of the system.

B1.3 UNDERGROUND PIPEWORK

Pipes laid underground shall conform to one of the following specifications: -

(a) BS EN 10255:2004 or ISO 65:1981 - Steel tubes and tubular of heavy grade for screwing to BS EN 10226-1: 2004 or ISO 7-1:1994 pipe threads, or

(b) BS EN 545:2002 - Ductile iron pipes and fittings, Class K12, cold bitumen coated externally to BS 3416:1991 Type II or better and lined internally with bitumen or cement mortar.

If not specified in the Particular Specification, ductile iron pipes and fittings in item (b) above shall be used.

Ductile iron pipes laid underground shall be coated externally with zinc. Metallic zinc content shall be not less than 99.9% by mass. The zinc coating shall be applied at the manufacturer's works to the oxide skin of the pipe surface. The zinc coating shall cover the external surface of the pipe to a mean density of 130 g/m^2.

Mechanical pipe couplings of approved type that can provide the required allowance for angular deflection and contraction and expansion shall be used for joints in underground pipes unless otherwise specified. Mechanical pipe coupling shall comply with Clause B1.5 where relevant.

B1.4 PIPE SIZES

Where pipe sizes are stated in this General Specification, this is intended to be the nominal bore in the case of steel tubes and the nominal outside diameter in the case of copper tubes.

B1.5 JOINTS IN STEEL PIPEWORK

Joints in steel pipe shall be made in accordance with the following general requirements, using the highest quality materials and skilled labour.

Flanged joints and flanged fittings shall be used for steel pipe of diameter larger than 150 mm. Flanged joints and flanged fittings shall also be used for steel pipe with working pressure higher than 1600 kPa unless otherwise approved by the Architect.

All flanged joints and fittings used shall be of factory-applied flanges. Welded flanges fabricated on Site shall not be accepted unless otherwise specified. Flanges shall be raised face to BS EN 1092–1, BS EN 1092 -2: 2002, BS EN 1092 -3: 2004 and BS EN 1515-1: 2000. Flanges for steel pipes shall be wrought iron or annealed steel, machined full face and galvanised, suitable for the working pressures and test pressure to which they will be subjected. For flanged joint pipes, facilities and design provisions shall be allowed and provided in the piping system to absorb all types of thermal movement, vibration, deflection and water hammering effect after installation.

Steel pipes less than or equal to 50 mm and operated at working pressure below 1600 kPa shall be jointed with screwed fittings, screwed flanges, or screwed unions. Screwed joints shall have tapered threads to BS EN 10226-1: 2004 or ISO 7-1:1994 and shall be made with approved jointing material. Where the process of cutting of threads removes galvanisation, the Contractor shall apply an approved cold galvanising finish to restore the integrity of the pipe protective finish. All fittings shall be galvanised. Screwed fittings other than sockets shall be of galvanised malleable iron. The pipes shall be fitted with screwed flanges for jointing valves and other equipment having flange connections.

Mechanical pipe couplings shall be employed for steel pipes of diameter larger than 50 mm up to 150 mm with working pressure on or below 1600 kPa unless otherwise specified. For working pressure on or below 1000 kPa, mechanical pipe couplings shall be of pressure class PN16, and for working pressure from 1000 kPa to 1600 kPa, the pressure class of mechanical pipe couplings shall be PN25.

Steel pipes of diameter larger than 50 mm up to 150 mm outside plant room when exposed to direct eyesight shall use flanged joints and flanged fittings. Mechanical pipe coupling may be used for such pipes only if prior approval is obtained from the Architect on its aesthetical appearance.

Flange adapter for plain-ended pipe should not be used generally and may only be used for steel pipes of diameter larger than 50 mm up to 150 mm with working pressure on or below 1000 kPa when approved by the Architect for connection to stationery equipment, apparatus and pipe fitting with flanged end.

The mechanical pipe couplings shall be self-centered, engaged and locked in place onto the grooved or shouldered pipe and pipe fitting ends. The pipe connection shall result in a positive watertight couple providing reasonable allowance for angular pipe deflection, contraction and expansion. The housing clamps shall consist of two or more malleable iron castings or rolled steel segment and securely held together by two or more trackhead square or oval-neck heat treated carbon steel bolts and nuts with a composition water sealing gasket so designed that the internal water pressure will increases the water tightness of the seal.

All pipes fittings connected to mechanical pipe couplings shall be of galvanised steel, or ductile iron castings grooved or shouldered ended suitable for the pipe couplings. The grooves on pipe shall be roll-grooved, or as approved by the Architect, without the removal of any metal. Pipe grooving shall be formed in accordance with the mechanical pipe coupling manufacturer's latest specifications. Flanged or threaded end valves may be used with grooved adapters.

Couplings or flange adapters for plain-ended pipes shall be cast iron or steel, slip-on type, or as approved by the Architect: -

Coupling shall consist of: -

(a) Sleeve (without centre register);
(b) End flanges;
(c) Sealing rings; and
(d) Bolts and nuts.

Flange adapter shall consist of: -

(a) End flanges/sleeves;
(b) Sealing rings; and
(c) Studs and nuts.

Before couplings are assembled, pipe ends and outsides of gaskets shall be lightly coated with grease or graphite paste to facilitate installation.

The entire mechanical pipe coupling installation shall be in accordance with the published manufacturer's recommendations and selected to withstand 2 times of working pressure of the pipe and be tested to 1.5 times of working pressure of the pipe. Where the pipes are laid underground, suitable mechanical pipe coupling of approved type that can provide the required allowance for angular deflection at ground settlement and contraction and expansion at changes of temperature shall be used.

Jointing of steel pipes by welding on site is only permitted where specified or with the expressed permission of the Architect. Only non-galvanised pipes of 50 mm bore or larger will be considered to be jointed by welding on site.

Welding of steel pipes shall be in accordance with the recommendations contained in BS 2633: 1987 and BS 2971 : 1991, : and machined fully over the raised and flat faces.

Where visual inspection or test reveals a welding joint which is reasonably believed to be unacceptable, the Architect shall be entitled to have such welding examined by radiography or other approved inspection method and independently assessed at Contractor's cost. The Contractor shall rectify all unacceptable works to the satisfaction of the Architect.

B1.6 JOINTS IN COPPER PIPEWORK

Joint fittings for copper pipes of diameter up to and including 54 mm shall be of the capillary or compression type to BS EN 1254 Part 1 and 2 : 1998. For copper pipework above 54 mm, fittings shall be of the flanged compression type. Only non-corrosive type of flux shall be used for jointing.

Brazing for copper pipes shall be in accordance with the recommendations contained in BS EN ISO10564.

Where visual inspection or test reveals a welding joint which is reasonably believed to be unacceptable, the Architect shall be entitled to have such welding examined by radiography or other approved inspection method and independently assessed at Contractor's cost. The Contractor shall rectify all unacceptable works to be satisfaction of the Architect.

B1.7 DISMANTLING FACILITIES

All pipe runs shall be arranged for ease of dismantling, servicing, repair, replacement, and re-erection. At dismantling points or where the pipe is connected to an appliance, ground-in spherical seated unions shall be used for pipe up to 50 mm diameter and flanges shall be used for pipework at 65 mm diameter and above.

Disconnecting flanges, mechanical pipe coupling or screwed unions, as applicable, shall be provided at suitable locations and at all valves and equipment, for ease of dismantling for maintenance and replacement.

Unions shall be of ground-in spherical seated type with hexagon bodies. Unions for steel pipes shall be of forged steel heavy-duty pattern and unions for copper pipes shall be of gunmetal. The flanges joints shall be to ISO 7005-1:1992 or ISO 7005-3:1988 of appropriate type and made with flat ring gaskets suitable for the pressure and temperature and extending to the inside of the bolt circles.

For non-welded pipework, connections shall be by means of screwed fittings, flanges or unions. The use of 'long screws' will not normally be permitted. Flanges shall be complete with appropriate gaskets, nuts, bolts and washers for connecting up all plant and equipment such that it can easily be removed for servicing or replacement.

B1.8 PIPEWORK INSTALLATION

Pitcher tees, bends, twin elbows etc. of pipework installation shall be of the same size as the pipes connected to them. Bushings shall not be used. Square tees shall only be used where short sweep fittings would cause air to be trapped.

Unless otherwise specified, long radius elbows shall be used in order to minimise hydraulic resistance and reduce turbulence. Short radius elbows may be used for pipe sized up to 50 mm diameter, and for pipes installed inside false ceiling or inside concealed void with limited spaces. Use of short radius elbows for pipe larger than 50 mm diameter in areas other than the spaces inside false ceiling and concealed void are not acceptable except with the expressed permission of the Architect where long radius elbows will not fit within a limited space or are not manufactured.

Tubes shall be reamed after cutting and shall be free from burrs, rust, scale, and other defects and shall be thoroughly cleaned and treated for corrosion protection before and after erection.

Open ends left during the progress of the work shall be properly blanked off with approved metal or wood plugs or blank caps or counter flanges.

Joints shall not be made in the thickness of any wall, floor or ceiling.

Pipework shall follow the contours of walls. Venting pipes and drain pipes shall be suitably graded to ensure proper venting and draining. Generally, pipework should avoid running near to or above electrical equipment, electrical appliances, cables, trunkings and conduits. The clearance between pipework and the wall and any other fixtures shall be not less than 25 mm.

Where two or more pipe runs follow the same route, all pipes shall run parallel with one another and to the building structure without prejudice to the necessary allowances for venting, drainage or other reasonable restrictions.

Where pipes pass through ordinary walls or floors, the Contractor shall, unless otherwise specified,

(a) Cast or build in galvanised mild steel pipe sleeves with 2 to 25 mm clearance to allow for expansion and movement of pipe;

(b) Finish sleeves flush with the finished face of walls unless concealed inside false ceiling;

(c) Project sleeves at least 100 mm above finished floor level;

(d) Fill the annular space between pipe and sleeve for the full length with approved fireproof materials and non-flammable type sealant;

(e) Provide loose chromium plated steel cover plates to ends of sleeves visible or exposed in completed work. Plates shall be 50 mm larger than the external diameter of pipe and either clipped to the pipe or screwed or plugged and screwed to the adjacent surfaces.

When pipes pass through fire rated walls or floors, the Contractor shall, unless otherwise specified,

(a) Cast or build in fire rated pipe sleeve with 2 to 25 mm clearance;

(b) Finish sleeves flush with the finished face of walls unless concealed inside false ceiling;

(c) Project sleeves at least 100 mm above finish floor level;

(d) Fill the annular space between pipe and sleeve for the full length with approved fireproof materials and sealant of fire resistance period not less than that of the separating wall and floor through which the pipe penetrates;

(e) Provide loose chromium plated steel cover plates to ends of sleeves visible or exposed in completed work. Plates shall be 50 mm larger than the external diameter of pipe and either clipped to the pipe or screwed or plugged and screwed to the adjacent surfaces.

Where pipes pass through building roofs, the Contractor shall, unless otherwise specified,

(a) Cast or build in fire rated pipe sleeves with 2 to 12 mm clearance projecting 150 mm above roof finish;

(b) Fill the annular space between pipe and sleeve and caulk all spaces and voids at both ends for the full length with approved fire rated materials and sealant, e.g. mastic sealant, add waterproof protection and sealant where necessary;

(c) Cover top of sleeves with watertight stainless steel collars or similar cover as per roofing specification;

(d) Pipework shall not be embedded in the concrete structure or "grouted in" or otherwise installed in such a way as to make subsequent alterations difficult at a later date.

Pipework connections to the suction and delivery outlets of pumps and other vibrating machines shall be isolated from such sources of vibration by means of anti-vibration devices with allowable stress levels as per PD 5500 : 2006.

The anti-vibration devices or couplings shall be of flexible metallic hose with corrugated seamless hose body. They shall be of the annular and close-pitched type as per following unless otherwise specified: -

(a) For all ferrous applications, the hose body and the braid shall be manufactured from stainless steel material. End terminations shall be carbon steel threaded male nipples to BS EN 10226-1: 2004 for 65 mm size and below and flanges to BS EN 1092 -1: 2002 NP Standard for 75 mm and above;

(b) For copper or non-ferrous pipes, the hose body and the braid shall be manufactured in bronze throughout. End terminations shall be copper female ferules suitable for soldering.

The anti-vibration devices shall be capable of attenuating the vibration of the plant such that the bulk of the vibrations are prevented from being transferred to the pipework. The length of the flexible metallic hoses shall be in accordance with the manufacturer's recommendation.

Wherever anti-vibration devices are installed, the adjacent pipework shall be adequately supported by guide type brackets.

B1.9 PIPEWORK SUPPORTS

All pipework shall be properly supported with substantial hangers, anchors, brackets, saddles, guide etc. with adequate provision for expansion and contraction and for corrosion protection.

Pipework supports shall be arranged as close as practicably possible to joints and changes of direction and each support shall take its share of the load. The spacing of the supports shall not exceed the centres given in the following table: -

Table 1 : Spacing of pipework support for mild steel and copper pipes

Nominal pipe size, mm	Spacing for vertical runs, m	Spacing for horizontal runs, m
Mild Steel		
15	2.5	2
20 and 25	3	2.5
32	3	3
40 and 50	3.5	3
65 and 80	4.5	3.5
100	4.5	4
125	5	4.5
150	5	5
200 and above	7.5	7.5
Copper		
15	1.5	1
22 and 28	2	1.5
35 and 42	2.5	2
54	3	2.5
76, 108 and above	3.5	3

Vertical rising pipework shall be supported at the base, or as indicated, to withstand the total weight of the riser. Branches from risers shall not be used as a means of support for the riser. If such base has to be rested on an intermediate floor slab, the Contractor must draw particular attention to the Architect for structural reinforcement to the floor slab and also allow for additional treatment to the base as required by the Architect.

Where pipework up to 50 mm is fixed to solid structure, brackets may be of the screw-on or long shank built-in type. Fixings to timber or to light-weight structure shall be of screw-on pattern. Brackets and supports for mild steel tube shall be galvanised steel or malleable iron and galvanised. Brackets for copper tubes shall be brass or gunmetal. The pipe clip shall be detachable without disturbing the fixing.

Brackets screwed to walls shall be securely fixed by expanding plugs of adequate size or other purpose-designed fixing devices of non-combustible material. Wood plug is not permitted.

Pipework of 65 mm size and larger subjected to expansion and contraction shall be suspended on swivel hangers or hangers having equivalent functions and performance to cater for expansion and contraction. The pipe hangers and supports shall be galvanised steel or approved materials for supporting the load of all the pipes filled with water.

Unless otherwise specified, hangers for horizontal pipework at high level shall be supported from angle or channel galvanised irons supplied and installed by the Contractor and suitable for building-in or otherwise secured to the structure. Tee hangers supported on two legs instead of one-leg angle hangers shall be used. Adjustable galvanised steel hangers shall be used. Pipe rings shall be of malleable iron or fabricated steel and galvanised, made in halves and secured by bolts or machine screws. Alternatively, galvanised malleable iron hinged pipe rings may be used. Calliper type hook is not permitted.

Where integral pipe hangers or supports are required for housing the fire service pipes and pipes for other services, the integral pipe hangers or supports shall be of material and type approved by the Architect and supplied by one manufacturer with all the accessories. Structural and load calculation shall be submitted for approval. The laying of pipes on the integral pipe hangers or supports shall be fully co-ordinated with other services before installation so that every pipe on the hanger is accessible for maintenance and future inspection.

B1.10 EXPANSION JOINTS

B1.10.1 General

Expansion joints shall be of metallic type fitted for all pipework passing through building expansion joints and where necessary as specified. All expansion joints shall be designed with a long cycle life to suit a pipe system with at least 20 years life expectancy and be installed properly without misalignment.

Unless otherwise approved by the Architect, non-metallic flexible connector of single sphere or double sphere type made from rubber, EPDM, fabric or similar materials shall not be used for the expansion joint.

B1.10.2 Axial Movement Pattern

Axial pattern bellow expansion joints shall have screwed or flanged ends as appropriate to facilitate replacement. They shall incorporate internal liners if required and shall be manufactured from BS EN 10088-1: 2005 No. 1.4401 stainless steel or better material to the approval of the Architect and shall be designed to withstand at least 2 times of the system pressure. External protective sleeves shall be fitted.

End termination to be carbon steel threaded male to ISO 7-1:1994 or carbon steel flanges to ISO 7005-1:1992 to suit the line pressures.

For copper or non-ferrous pipes, expansion joints shall be manufactured in stainless steel throughout. The bellow expansion joints shall be installed with pre-cold setting to their required length to suit the temperature condition at the time of installation. The joints shall be rated suitable for the required amount of designed axial movement and shall be capable of performing the required cycles to suit a pipe system with at least 20 years life expectancy. Mild steel outer protection sleeves shall be fitted to the bellows only when the units are open to the environment and exposed to risk of damage or when it is necessary to carry lagging over the joint.

Units should be installed in strict accordance with the manufacturers recommendations. Manufacturers of expansion joints should be approved to ISO 9001:2000.

B1.10.3 Angular or Lateral Movement Pattern

These bellow expansion joints shall generally comply with the requirement of anti-vibration devices or couplings as specified in this General Specification. Hinge and shackle or centre joining tube, tie bars and spherical nut arrangement shall be carbon steel to ISO 9692-1:2003 fully designed to contain the pressure thrust. End termination shall be flanged to ISO 7005-1:1992 to suit the line pressures.

The joints shall be designed to meet the required angular movement or the required movement in all directions perpendicular to the axis of the bellows.

B1.10.4 Provision for Anchors and Guides

Anchors and guides shall be installed according to the recommendations of the expansion joint manufacturer and the details shall be submitted to the Architect for approval before manufacture commences.

(a) Anchors

Allowances shall be made for anchors capable of withstanding the maximum stresses created within the pipework system, and have adequate safety margin. These shall be positioned as indicated on the layout drawings or as necessary shop drawing/details introduced by the Contractor.

For steel pipework, the pipes shall be welded to the anchors using heavy steel straps. For copper pipework, the pipes shall be brazed to the anchors using heavy copper straps.

(b) Guides - Axial Movement Pattern

The pipework shall be guided along its length and the guides shall be capable of withstanding not less than 15% of the maximum stresses created within the pipework system and have an adequate safety margin.

Guides shall be adjustable in both directions in the lateral plane, so that pipework can be accurately aligned with the expansion joint.

Each guide shall not be less than 2 pipe diameters' long and shall have a minimum manufacturing clearance of the pipe diameter.

The distance from the expansion joint to the first guide must not be greater than 4 pipe diameters, and the distance between the first guide and the second guide must not be more than 14 pipe diameters. Guides thereafter should be spaced in accordance with normal pressure performance requirements as a minimum standard.

(c) Guides - Angular or Lateral Movement Pattern

Directional guiding shall be applied, such as side plates, local to the expansion joint, the remainder of the pipework should be supported pipework hangers.

A combination of axial, angular or lateral movement guides in one location shall not be permitted.

B1.11 PROTECTION OF UNDERGROUND PIPEWORK

Underground pipes shall be protected against corrosion and against mechanical damage. Pipework shall be cleaned after jointing and treated and coated with at least two coats of good quality bituminous paint and wrapped with corrosion and water resistance self-amalgamating tapes and mastics, or protective materials as approved by the Architect, having minimum 55% overlapping before laying, and bedded in washed sand free of all salts or sieved soil before the trench is back filled. All joints and supports shall be appropriately wrapped. Pipework shall be hydraulically tested before the trench is back filled. Underground pipework shall be provided with suitable and approved couplings which provides allowance for angular deflection, contraction and expansion. Adequate anchor blocks shall be provided at appropriate intermittent positions of the pipes to the approval of the Architect for thrust bearing. Anchor blocks, trench, backfilling of trench and sand bed are included under the builder's works detailed in other parts of this General Specification.

B1.12 PIPE ENTRIES INTO BUILDINGS

Pipe entries into buildings shall be sealed with mastic compound and plugged after installation of pipework to prevent the ingress or egress of water or vermin.

B1.13 VENTING AND DRAINING

Devices for air venting (e.g. automatic air vents, or air cocks where specified) shall be provided at the highest points of the sections where they are intended for venting throughout the piping system.

The automatic air vent shall have gunmetal or brass bodies, non-corrodible valves seats, non-ferrous or stainless steel floats and guides. Each automatic air vent shall be controlled by a lock-shield valve. Air release pipes shall be run to discharge at the nearest suitable visible point. Air cocks shall be nickel-plated, of the spoutless pattern and with screwed taper thread.

All air release pipes shall be run to discharge at the nearest suitable visible point.

The drain valves shall be fitted on the lowest points of pipework and where necessary for water drainage of the system. The drain valves shall be checked to have closed before the system is put into operation.

The drain valves shall be connected to the nearest building floor drain or drain point of adequate size. Three loose keys of forged mild steel shall be provided for each type of drain cocks and drain valves installed.

B1.14 VALVES, TAPS AND COCKS

Valves, taps and cocks shall be of the types and working pressures suitable for the systems to which they are connected. Letters of approval issued by the Water Supplies Department shall be submitted for inspection upon requested.

Wherever applicable, the following British Standards for cocks and valves shall be relevant: -

BS 1552: 1989	Specification for manual shut-off valves for use with 1st, 2nd and 3rd family gases.
BS 5159: 1974	Cast iron and carbon steel ball valves for general purposes DN Series PN16.
BS 5163-1: 2004	Key-operated cast iron gate valves for water works purposes DN Series PN16.
BS EN 1171: 2002	Industrial valves. Cast iron gate valves
BS EN 12288: 2003	Industrial valves. Copper alloy gate valves
BS EN 12334: 2001	Industrial valves, cast iron check valves.
BS EN 13397: 2002	Industrial valves. Diaphragm valves made of metallic materials
BS EN 13789: 2002	Industrial valves. Cast iron globe valves

Valves and fittings of PN16 shall be used for working pressure up to 1000 kPa. Valves and fittings of PN25 or heavier duty shall be used for working pressure up to 1600 kPa. Valves and fittings of heavy duty of appropriate pressure rating approved by the Architect shall be used for high-pressure system above 1600 kPa. All components in the fire service installations and equipment shall be designed to withstand at least 2 times of the working pressure and be tested to at least 1.5 times of the working pressure unless otherwise specified. The working pressure is the maximum pressure anticipated during the working period and it may be higher than the normal system pressure.

All valves shall be arranged so that clockwise rotation of the spindle shall serve to shut off the valve. Valves shall not be installed at locations with a change in direction of the pipework.

Isolating valves shall be of the full way gate type. Regulating valves shall be of globe type, unless otherwise specified. Globe valves shall be positioned so as not to prevent draining of the system.

Bodies of valves and cocks up to 50 mm shall be of cast gunmetal or bronze. Valves having heavy pattern hot-pressed bodies may be used subject to the approval of the Architect. Valves over 50 mm shall have cast iron bodies with bolted cast iron bonnet, bronze wedge and seat, forged manganese bronze or high tensile bronze spindle, with graphite packing and compressed fibre. Castings and pressings shall be of good quality, clean and smooth and free from scale or flaws.

All working parts shall be of gunmetal or bronze or stainless steel. Spindles shall be of high tensile bronze, forged brass or stainless steel with Teflon or approved packing to the manufacturer's standard. Glands shall be machined to provide a naming fit between the spindle and the stuffing box. Stuffing boxes shall be properly packed, or fitted with 'O' rings. Gate valves shall have split or solid wedge gates of bronze with bronze seats. Disc valves shall have renewable discs free to rotate on the spindle.

Valves and cocks for screwed jointed pipework installation shall have taper screwed ends. Flanges of flanged valves shall be to BS EN 1092 -1: 2002 for PN16 or PN25 for higher pressure rating.

Operating hand wheels shall be of malleable iron, or of approved composition having metal insert for securing positively to the stem.

Outlets valves on fire service water tanks, sprinkler installation, and elsewhere as specified, shall have padlocks and leather straps capable of locking the valves in the "OPEN" position.

Non-return valves shall be so constructed that minimum resistance is offered in the normal direction of flow. The body of the check valves shall be made of cast iron to BS EN1561:1997 while the flaps/discs shall be made of bronze to ISO 197-4:1983 or ductile cast iron. The discs of check valves shall be of light construction and pivoting on a gunmetal, bronze or stainless steel spindle. Each valve shall be fitted with a stop to prevent undue movement of the flap and shall be as silent as possible in operation.

The discs of lift check valves shall be provided with means of guiding the discs and preventing components from becoming detached in service. Recoil check valves with size 100 mm and above should have removable cover on top of the outlet body casing to facilitate inspection of bearings and movement door.

Pressure reducing valves for direct connection in hose reel branch pipes, and elsewhere as specified, shall be of approved spring-loaded relay-operated type or otherwise constructed to prevent high pressure build-up on the low pressure side. Each reducing valve shall be installed with an isolating valve and strainer on the high-pressure side, excess pressure isolating valve or relief valve on the low pressure side, pressure gauge with mild steel siphon and bronze cock followed by down-stream side isolating valve. Pressure reducing valve shall be of reliable construction and comply with BS EN 1567: 2000.

Pressure reducing valves shall be installed in set of two valves to provide backup in case of failure of any one valve. Unions shall be provided on the pressure reducing valve side of both isolation valves in order to facilitate removal of the pressure reducing valve set for servicing or replacement. Where indicated, a bypass valve shall also be installed.

Pressure reducing valves for hydrant outlets (parity valves) shall be of the type having relief connection to drain (see Clause B2.4) unless otherwise specified.

Butterfly valve shall be capable of bubble tight shut off. Butterfly valve shall comply with BS EN 593: 2004.

B1.15 PRESSURE GAUGES

Pressure gauges shall be provided at suction and discharge sides of water pumps and in other parts of the installation as required and used solely to indicate the pressure.

Pressure gauges shall conform to BS EN 837-1: 1998 and shall have brass cases with dials not less than 100 mm diameter. They shall be provided with an adjustable red pointer set to indicate the normal working pressure or head of the system. They shall be calibrated in kPa to a maximum of not less than 1/3 times and not more than 2 times the operating pressure of the respective equipment/system and shall be accurate to 1.5% of full scale reading, unless otherwise specified. Divisions of scale shall not exceed 20 kPa for a maximum scale value of 1000 kPa, 50 kPa for a maximum scale value of 1600 kPa and 100 kPa for maximum values in excess of 1600 kPa. Pressure gauges shall be fitted with an isolating valve/lever handle cocks and shall have siphon pipes, pigtail with 2 complete turns minimum or pulsating damper, fitted between them and the system pipework..

B1.16 ELECTRIC ALARM PRESSURE SWITCHES

Electric alarm pressure switches shall have contact sets of silver or approved alloy rated to suit the working voltage and current of the circuits controlled and shall have independent adjustments for the cut-in and cut-out points and for the operating differential. Electric alarm pressure switches shall be of LPCB approved type or approved by similar widely recognised independent regulatory body. The maximum working pressures of all pressure switches shall be at least 300 kPa above the maximum pressure of the water inside the pipework at the positions of installation of the switches. Pressure switch shall be supplied and installed with necessary ancillary facilities and isolating valves for maintenance and hydrostatic pressure test purpose complying with LPC Rules for Sprinkler Installations and of arrangement shown in LPC Technical Bulletin TB 10. All isolating valves where provided shall be complete with padlocks.

B1.17 WATER FLOW ALARM SWITCHES

Water flow alarm switches shall be of magnetic type having the water side completely separated from the electrical side. Contacts shall be suitable for the working voltage and current of the circuits controlled, and shall be of silver or approved alloy. Water flow alarm switches shall be of a type approved by LPCB or similar widely recognised independent regulatory body. They shall be capable of standing a test pressure of minimum 1600 kPa or 1.5 times the working pressure whichever is higher for 6 hours without showing any sign of leakage.

B1.18 PIPELINE STRAINERS

Water strainers shall be installed in all pipelines upstream of all water pumps. For pipelines of nominal bores between 15 mm and 50 mm diameter inclusive, strainers shall be screwed gunmetal or bronze body "Y" type with brass or stainless steel screen. For pipelines of nominal bores of 65 mm diameter or above, strainers shall be flanged with "Y" type cast iron body, brass or stainless steel screen. Straining cages shall have 1.5 mm diameter perforations or finer if indicated. Cage shall be at least five times the cross-sectional area of the pipe

B1.19 BALL FLOAT VALVES

Ball float valves up to 50 mm shall be of cast gunmetal or bronze body. Ball float valves over 50 mm shall be of cast iron body. They shall be with nickel alloy and stainless steel working parts. They shall be of a slow closing type and of minimum PN10 pressure rating or higher to suit the system pressure.

B1.20 VORTEX INHIBITORS

Vortex inhibitors shall be LPCB approved type or approved by similar widely recognised independent regulatory body for PN16 and flanged. They shall be used for operation under positive head conditions.

B1.21 ORIFICE PLATES

Orifice plates for system balancing, pump churning water circuits, where applicable, shall be supplied and installed as required for proper commissioning of the systems, whether they are shown in Drawings or not. Wherever necessary to suit the pump or system performance or in respect of system balance, an orifice plates shall be supplied and installed even if they are not indicated in Drawings.

Orifice plates shall be generally constructed and installed according to LPC Rules for Sprinkler Installations. They shall be manufactured by factories producing LPCB approved equipment or UL listed sprinkler equipment, or from suppliers approved by similar widely recognised independent regulatory body, and acceptable to the Architect. Orifice plate that has been factory calibrated and produced by a factory having a recognised quality control system in place may be used if they are acceptable by the FSD. The flow characteristic data of the orifice plate shall be included in the operation and maintenance manual.

B1.22 CLEANING AND DRAINING

All piping shall be cleaned and shall be free of scale, dirt etc., before installation. During the course of the installation, all open ends of pipes shall be plugged or capped to prevent ingress of dirt. After installation and sealing of joints all piping shall be thoroughly flushed with clean water under pressure, to the satisfaction of the Architect. Water used for this purpose shall be discharged as directed.

Any temporary pipework and equipment necessary for the above cleaning and draining work shall be provided by the Contractor.

SECTION B2

HYDRANT AND HOSE REEL SYSTEM

B2.1 GENERAL

The general requirements of the hydrant and hose reel system and the individual equipment installations shall comply with FSDCoP, FSD Requirements and Circular Letters.

The fire service inlets, hydrant outlet valves and hose reels shall be FSD approved type. These equipment shall be stamped with relevant British Standard Mark or accompanied with a valid letter of approval issued by the Water Supplies

B2.2 FIRE SERVICE INLETS AND HYDRANT OUTLETS

Fire service inlets shall be of twin type comprising screw-down globe type stop valve with male screwed outlet of suitable bore and two 65 mm horizontal male instantaneous inlet connections complete with integral spring loaded resilient-seated non-return valves.

Hydrant outlets shall be single or double type comprising screw-down globe type stop valve for each outlet branch and with male screwed inlet of suitable bore and 65 mm female instantaneous outlets. Outlet branches shall incline at 70° from the centre line of the hand wheel, and at 90° to each other where applicable. The coupling control shall be located at the side of each outlet branch. A bronze blanking cap held captive by a suitable chain shall be fitted to each female outlet.

The fire service inlets and hydrant outlets shall be of full gunmetal construction except for the hand wheel which shall be of cast iron or hard aluminium alloy.

The inlet and outlets fittings shall be supplied and manufactured to the quality of material, construction, and dimensions as detailed in the following British Standard Specification or equivalent and approved: -

(a) Hydrant assembly to BS 5041-1: 1987;

(b) Major valve components of gunmetal to BS EN 1982: 1999;

(c) Globe & check valve of service rating 1000 kPa to BS 5154 or BS EN 12288: 2003;

(d) Male and female instantaneous terminals of 65 mm diameter to BS 336: 1989;

(e) All fittings shall be tested to at least 2000 kPa.

B2.3 VENTING AND DRAINING

All hydrant risers shall be supplied and installed with automatic air vents of 25 mm size at the highest points and drain valves at the lowest points of the systems as specified in Clause B1.13.

B2.4 PRESSURE REDUCING HYDRANT OUTLETS

Pressure reducing hydrant outlet shall be supplied and installed at outlet locations where the static and pump pressure exceeds 700 kPa.

The pressure reducing hydrant outlet shall be in the form of a parity valve incorporated in the hydrant outlet and valve assembly with suitable connection to the drain pipe not less than 40 mm diameter. Alternatively, where specified, the pressure reducing hydrant outlet can be in the form of self-contained type without the use of the parity valve and drain pipe. It shall be capable to reduce the running pressure and satisfy the flow test requirements. The pressure reducing mechanism of the valve shall be located at down stream of the valve seat. Pressure reduction shall be achieved by means of hydraulic pressure balancing with metal diaphragm. The 100% effectiveness pressure reducing performance shall be maintained at all times of operation.

B2.5 HOSE REELS

Hose reels shall be of fixed or swing-out type to suit the site installation conditions. The construction, testing, performance, working pressure etc. shall be to the FSD Requirements and Circular Letters. The length of hose shall be 30 m and bore 19 mm. Additional length of hose shall be provided where specified in the Particular Specification.

Drums shall be constructed of die cast light alloy, hydraulically balanced, free from denting and twisting, and finished in red enamel. The hub and shaft shall be of brass, fitted with a device to prevent overrun of the hose, having a glandless centre seal. The entire assembly shall be drip free. Hoses shall be of reinforced rubber or P.V.C. tubing approved by the Architect and shall be fitted with a copper alloy nozzle having slow-closure type lever-operated cock.

A hose guide complete with nylon or similar runners shall be supplied and installed adjacent to fixed type hose reels to enable the free run out of the hose in any direction as required.

For the wall fixed type, wall-mounting brackets of substantial construction shall be capable in supporting the entire weight of the hose reel and tubing under all operating conditions as required.

For the swing-out type, the support brackets and the swing-out arm shall enable the whole hose reel assembly to be swung through 180^{o} in a horizontal plan.

Each hose reel nozzle shall be housed inside a glass fronted metal box. The box shall be fabricated from sheet metal not less than 0.8 mm thick with a hinged door with front break glass and padlocking facility. The metal box shall be painted and finished to the satisfaction of the Architect. The break glass shall be of fragile type not more than 1.5 mm thick. The break glass shall be easily replaced. Common key shall be used for the padlocks. Five common keys shall be provided. A metal or plastic striker about 300 mm long, secured by steel chains, shall be provided for each box for the purpose of breaking the glass panel in case of emergency.

In case only the hose reel and/or its associated pumping system are activated while fire alarm signal is not received from other fire service systems such as manual call points, sprinkler system, automatic fire alarm system etc., no fire signal shall be sent via the fire alarm direct link to the FSD's approved centre unless otherwise specified. A visual indication and audible alarm shall however be energised on the master panel of fire alarm control system as well as on all local and repeater panels.

B2.6 CABINETS

Cabinets housing the fire service inlets, hydrant outlets and hose reels shall be provided by the Building Contractor unless otherwise specified. The Contractor shall furnish and propose all necessary information for the cabinet including dimensions and weights, based on BS 5041-1: 1987, for approval in order to enable these cabinets to be designed and constructed. The Contractor shall include all details in the builder's work drawings for construction by the Building Contractor unless otherwise specified.

Where hose reels are located in cabinets or recesses to which doors are fitted, the doors shall bear the words "FIRE HOSE REEL (消防喉轆)" in both English and Chinese characters prominently and easily identifiable from all lines of sight within the surrounding. In the case of doors which can only be opened by pushing in first, they shall also be annotated "PUSH TO OPEN (按下開門)" in both English and Chinese. Hose reel cabinets fitted with doors shall not be locked. They shall be easily identified and shall be opened without difficulty at the time of emergency. All doors and equipment shall be properly labelled by the Building Contractor unless otherwise specified.

B2.7 STREET HYDRANT SYSTEM

Street hydrants shall be of pedestal type manufactured of cast iron. The construction of the street hydrants shall comply with the requirements of the Water Supplies Department and the FSD. They shall be in accordance with the Standard Mains Laying Practice of the Water Supplies Department.

The hydrant, when tested in accordance with the provision of BS 1042-1.4: 1992 with one 65 mm outlet working, shall be capable of delivering water flow not less than 2000 litres per minute (33.3 l/sec.) with a minimum running pressure of 170 kPa at the outlet. In the case of twin 65 mm outlets with both outlets delivering water at the same time, the minimum water flow shall be not less than 4000 litres per minutes (66.7 l/sec.) and a minimum running pressure of 170 kPa.

Where the minimum standards are not achievable with direct supply from town mains, the water supply shall be augmented by water tanks and booster pumps. The booster pumps, pipework and controls shall be provided by the Contractor and the water tanks will be provided by the Building Contractor under builder's works unless otherwise specified.

The Contractor shall check in advance the pressure and water flow available from Water Supplies Department and shall arrange necessary tests on the pressure and flow from town mains water supply at a nearby location approved by the Architect at early stage after the commencement of the Contract. The Contractor shall submit to the Architect for approval at early stage in providing booster pumps and tanks for the street hydrant system if the water supply pressure and flow from the town mains are not adequate to meet with the requirements of the FSD. Any delay in the completion of the Fire Service Installation due to inadequate pressure and flow of the street hydrant system found only during the testing and commissioning of the system shall be the responsibility of the Contractor unless the Contractor can demonstrate that all practical steps have been taken to co-ordinate with relevant parties to obtain the information and to arrange all necessary tests at early stage.

The Contractor shall note WSD Circular Letter No. 1/2007 on the reduction of minimum residual pressure and check for the necessity of water tanks and booster pumps at early stage.

B2.8 TANKS AND WATER PUMPS

Tanks and pumps shall comply with clauses in Section B4.

Two sets of automatic fire pumps, one as duty and one as standby, each capable of delivering the required flow and pressure as required by FSDCoP, FSD Requirements and Circular Letters shall be supplied and installed.

The fixed fire pump for fire hydrant and hose reel system shall be actuated by the manual fire call point or other devices as specified and shall continue to run until stop manually with start/stop buttons. Should the duty pump fail to operate within fifteen (15) seconds the standby pump shall be energized to serve as the duty pump.

The hydrant and hose reel systems shall be permanently primed with water. If the fire service water tank is located below the highest hydrant outlet or hose reel, a jockey pump shall be supplied and installed to maintain an adequate pressure for the entire system. The jockey pump shall be set to operate at 95% of the required system pressure and stop when the system pressure is restored to 100% level. Interlock shall be supplied and installed such that the jockey pump shall stop operation when the fire pump is put into operation.

The fire pumps for the street hydrant system shall be actuated by a flow switch or pressure switch in accordance with approved design. Should the duty pump fail to operate within fifteen (15) seconds the standby pump shall be energized to serve as the duty pump. Jockey pumps shall be provided as necessary.

If any pump fail to operate, visual and audible warnings shall be activated.

Where the tanks are provided by the Building Contractor under the builder's works, the Contractor shall co-ordinate with the Building Contractor and check that the net effective water storage capacity is adequate to meet the fire service requirements.

B2.9 CONTROLS

The control system, where applicable, shall comply with clauses in Section B8 of this General Specification, FSDCoP, FSD Requirements and Circular Letters. All associated electrical wiring and installation shall comply with clauses in Section B9.

To prevent unauthorised use of water, flow switch and/or pressure switch shall be installed in the system to give visual and audible warnings in the event that significant system flow or loss of pressure is detected during no fire alarm situation.

B2.10 TEMPORARY WATER RELAYING FACILITIES

For construction of high-rise buildings or super high-rise buildings, the Contractor shall arrange early commissioning of the hydrant system and, where specified, provide temporary water relaying facilities, fire service equipment and water tanks at the Site during the construction period. The provisions shall be in accordance with FSD Circular Letter No 4/96 and as approved by the FSD.

The Building Contractor will be responsible for providing temporary water relaying facilities unless otherwise specified. Where the Contractor is required under the Particular Specification to provide temporary water relaying facilities, the Contractor shall supply and install temporary hydrant system, hose reels, portable hand operated approved appliances, water tanks, pumping system and other equipment complying with the requirements of FSD and WSD and other site safety requirements in the construction period. All technical requirements in this General Specification shall be complied where relevant.

If temporary water supply is to be obtained from WSD, temporary water supply shall be obtained downstream of the water meter for the Building Contractor's construction supply. Temporary water relaying facilities shall be supplied off-tank during the construction period.

SECTION B3

AUTOMATIC SPRINKLER SYSTEM

B3.1 GENERAL

Sprinkler system shall be installed in accordance with the following standards and requirements: -

(a) Loss Prevention Council Rules for Automatic Sprinkler Installations (including all the LPC Technical Bulletins, Notes, Commentary, and Recommendation) incorporating BS EN 12845: 2003, FSD Circular Letter No. 3/2006, and all the subsequent amendments by the FSD;

(b) Codes of Practice for Minimum Fire Service Installations and Equipment and Inspection and Testing of Installations and Equipment published by the Government of the HKSAR;

(c) FSD Circular Letters and other requirements of the FSD; and

(d) Rules of the Fire Offices' Committee, United Kingdom, for Automatic Sprinkler Installations, BS 5306 Part 2:1990, FSD Circular Letter No. 2/94, and previous edition of Loss Prevention Council Rules for Automatic Sprinkler Installations including Notes, Commentary, Recommendations and Technical Bulletins (only be used where specified for existing installations in the Particular Specification and as approved).

B3.2 DEFINITION OF TERMS

For the definitions of terms used for sprinkler systems, reference shall be made to the LPC Rules for Sprinkler Installations, FSDCoP and relevant FSD Requirements and Circular Letters.

B3.3 TYPES OF SYSTEMS

Types of sprinkler systems are as defined in the LPC Rules for Sprinkler Installations.

B3.4 CLASSIFICATION OF FIRE HAZARD

The LPC Rules for Sprinkler Installations has defined various classes of fire hazard according to the occupancy of the building to be protected.

B3.5 GRADING OF SPRINKLER SYSTEMS

Sprinkler systems are graded according to the number and type of water supplies available. Reference shall be made to the LPC Rules for Sprinkler Installations.

B3.6 TYPE OF WATER

Unless otherwise specified, the sprinkler system shall be suitable for use with fresh water connected from the town mains.

B3.7 BRANCH CONNECTION TO WATER SUPPLY SYSTEM

Whenever a direct feed town mains, gravity tank or other supply systems are used to supply the sprinkler system, no branch connection for any other purpose, hose reels included, is permitted.

B3.8 ANTI-POLLUTION VALVE FOR DIRECT CONNECTION TO TOWN MAINS

For sprinkler systems without water storage tanks and supplied from a direct connection to town mains, an additional butterfly valve (anti-pollution valve), without stop screw and lock nut on handle and strapped in open position to the Water Supplies Department Specification shall be fitted to the sprinkler installation at a point between the town mains connection and the sprinkler inlet.

The anti-pollution valve shall be installed in accordance with the FSD Requirements and Circular Letters and the WSD's requirements.

B3.9 SPRINKLERS

Sprinkler for general application shall be of LPCB approved conventional type or type approved by similar widely recognised independent regulatory body. Spray sprinkler shall be used only where specified and approved. The sprinkler shall not be altered in any respect nor have any type of ornamentation or coating applied after leaving the production factory. Unless otherwise specified, sprinkler shall be quick response type approved by LPCB or approved by similar widely recognised independent regulatory body with the approval of the FSD. For sprinkler system designed for high hazard group, the sprinkler shall in addition be designed to provide appropriate water droplet sizes for the type of hazard and goods they protected.

Sprinkler shall be constructed with the appropriate characteristics, to suit each particular application. The sprinkler shall be of pendant, upright or side wall type to suit the installation requirements in accordance with the LPC Rules for Sprinkler Installations and FSD Requirements and Circular Letters. Each sprinkler may be defined by any of the following characteristics: -

(a) Nominal size of orifices;

(b) Type of heat-operated element;

(c) Operation temperature;

(d) Type of deflector.

Unless otherwise specified, glass bulb sprinkler shall be constructed with heat sensitive quartzoid bulb with temperature rating of 68^{o}C. Sprinklers installed in heated rooms, e.g. kitchen cooking area, autoclave room, boiler room etc. shall have a temperature rating of 93^{o}C or as required by the FSD unless otherwise specified.

Sprinkler installed at the false ceiling shall be of flush pattern, pendant type and be supplied and installed with an adjustable screw type escutcheon and adaptor to be installed flush with the false ceiling with the yoke and heat sensitive element exposed below the false ceiling line. Sprinkler heads shall be installed at the centre line of the ceiling tiles. The sprinkler head assembly including the yoke arm, escutcheon, adaptor and cover plate installed in exposed locations shall be chromium plated or finished to a polyester white colour or a colour to be approved by the Architect. The sprinkler head concealed inside false ceiling shall be of natural brass finish or of the same finish as the sprinklers in exposed locations.

Dry pendent sprinklers where specified for pre-action system shall be of adjustable standard or recessed type providing vertical adjustment needed for accurate fit to false ceiling level. The escutcheon shall match the other sprinklers.

Dry pendent sprinklers shall consist of a valve mechanism which utilizes the centre strut in compression principle to seal water and air from the sprinkler pipe until the sprinkler is operated. Water shall then flow freely through the operated sprinkler and distributed by its deflector.

The sprinklers shall cover all areas in the sprinkler-protected building including staircases, common corridors and toilets except plant rooms/Dangerous Goods Stores/cold storage and other special areas that are provided with other fire service systems acceptable to the FSD.

B3.10 SPRINKLER GUARDS

Sprinklers shall be protected by approved metal guards at locations where they are installed at a height less than 2 metres from ground level or any locations liable to accidental or mechanical damage or required by the FSD. Sprinkler guards shall be made from brass, wax coated or approved products having equivalent functions and performance for corrosion resistance. It shall be of size not more than 65 mm high.

B3.11 SPACING AND LOCATION OF SPRINKLERS

Spacing and location of sprinklers shall be in accordance with the LPC Rules for Sprinkler Installations.

The Contractor shall check the actual site conditions before and during installation works to ensure that the sprinkler installation complies with the LPC Rules for Sprinkler Installations. The Contractor shall inform the Architect well in advance of any necessary change of pipe sizes or sprinkler layout in order to suit the finished architectural layout. The Contractor shall be held responsible for the taking down and re-fixing works without charges if he/she fails to check and inform the Architect in good time about such alterations.

The Contractor shall supply and install metal baffles of the correct size between sprinklers wherever required by the LPC Rules for Sprinkler Installations.

B3.12 SPARE SPRINKLERS

The Contractor shall supply and install a cabinet containing a minimum number of spare sprinklers for each type of sprinklers as recommended by the LPC Rules for Sprinkler Installations or as specified. Sprinkler spanners as supplied by the manufacturers of the sprinklers shall also be provided and kept in the cabinet. Where quick response sprinklers or fast response sprinklers are provided in the Works, an adequate quantities of spare quick response / fast response sprinklers shall be supplied and maintained as recommended by the LPC Rules for Sprinkler Installations or as specified. Where both conventional sprinkler heads and quick response / fast response sprinkler heads are provided in an installation, the number of spare sprinklers for each type of sprinkler head shall be considered separately and each shall comply with the recommendation in the LPC Rules for Sprinkler Installations for any hazard class.

B3.13 PIPEWORK INSTALLATION

Pipework installation for sprinkler systems shall be installed in accordance with the LPC Rules for Sprinkler Installations and as detailed in Section B1. In case of conflict of the two requirements, the LPC Rules for Sprinkler Installations shall be adopted while any additional and more stringent requirements in Section B1 shall be included and provided.

Where the installation works require temporary suspension of parts of the fire service installation inside or outside the Site such as in landlord's area, the Contractor shall obtain landlord's and relevant parties' consent, inform the FSD and provide all necessary temporary facilities, protection, and fire safety precautionary measures in all affected areas to the satisfaction of the Architect, landlord/client/occupiers, and the FSD during the suspended period and shall advise the landlord/client/occupiers to stay alert and to make corresponding management action. Draining the water in pipes of existing system inside or outside the Site, where required for the installation works, including its reinstatement and expenses for checking by landlord's maintenance contractor after lifting of the temporary suspension is the responsibility of the Contractor. The Contractor shall, except if and so far as the Contract otherwise provides, or unless otherwise provided by the Building Contractor for the Works, indemnify and keep indemnify the Employer against all losses and claims for injury or damage to any person or property whatsoever which may arise out of or in consequence of the temporary suspension of parts of the fire service installation for the execution of the Works and against all claims, demands, proceedings, damages, costs, charges and expenses whatsoever in respect thereof or in relation thereto.

B3.14 PRESSURE GAUGES, VALVES AND ALARM DEVICES

Pressure gauges, various types of valve and alarm devices shall be installed in accordance with the LPC Rules for Sprinkler Installations.

B3.15 CABINETS FOR CONTROL VALVE SETS AND SPRINKLER INLETS

Construction of the sprinkler inlet shall be the same as fire service inlet described in Section B2. Cabinets for housing the sprinkler control valve sets and sprinkler inlets shall be constructed by the Building Contractor unless otherwise specified. The Contractor shall furnish and propose all necessary information for the cabinet including dimensions and weights, based on BS 5041 -4: 1975, for approval in order to enable these cabinets to be designed and constructed. Labelling and lettering shall be in accordance with FSDCoP, FSD Requirements and Circular Letters. The Contractor shall include all details in the builder's work drawings for construction by the Building Contractor unless otherwise specified.

B3.16 TANKS AND PUMPS

Tanks and pumps shall comply with clauses in Section B4.

Two sets of automatic pumps, one as duty and one as standby, each capable of delivering the required flow and pressure as required by the LPC Rules for Sprinkler Installations for the appropriate hazard class shall be supplied and installed.

A jockey pump shall be supplied and installed to maintain the required system pressure.

The sprinkler duty and standby pumps and jockey pump shall be controlled by means of independent LPCB approved pressure switches suitable for starting pumps. Automatic changeover shall be supplied and installed such that the standby pump shall be put into operation, after a preset time lag, in case there is a fault at the duty pump as sensed by the pressure switches at the common header. The sprinkler pump shall be set to operate when the system pressure has fallen by 200 kPa or dropped to a value less than 80% of the pressure attained when the pump is churning with the installation in the standby condition, whichever is the least reduction. The pump shall continue to run until stopped manually with start/stop buttons. In addition to pressure switches, the sprinkler pumps shall also be activated manually at the pump room and the fire alarm control and repeater panels for indicating purpose..

The jockey pump shall be set to operate at 95% of the system pressure and shall stop when the system pressure is restored to 100% level. The capacity of the jockey pump shall be so selected that it cannot support full flow of an operated sprinkler. Interlock shall be supplied and installed such that the operation of jockey pump shall cease to operate when the sprinkler pump is put into full operating conditions in response to a reduction in system pressure.

A pump output test facility shall be supplied and installed to permit a running pressure test of the pump at full load condition or at nominal rating as appropriate. The test facility shall include a LPCB approved direct reading flow meter suitable for sprinkler service. The waste water discharge pipe shall be connected, wherever practical, back to the sprinkler water tank.

B3.17 CONTROLS AND ALARM INDICATIONS

The control and alarm indication shall comply with clauses in Section B8 and the LPC Rules for Sprinkler Installations. All associated electrical wiring and installation shall comply with clauses in Section B9.

Tamper-proof electric switch or approved indication to indicate the correct operational mode of each stop valve in the sprinkler system shall be supplied and installed complying with the LPC Rules.

B3.18 WATER FLOW ALARM SWITCHES

Water flow alarm switches as detailed in Clause B1.17 and LPC Rules for Sprinkler Installations shall be utilized for sending a signal back to the fire alarm control and indicating panel to indicate which location is under operation with both visual indication and audible alarm. LPCB approved high sensitive water flow alarm switch capable of actuation by operation of one sprinkler head shall be used.

Where specified, LPCB approved automatic flow switch testing system shall be supplied and installed for sprinkler flow switches installed in a position difficult to be accessed or checked in routine inspection such as those inside false ceiling, at level higher than 2m above ground etc. The controlling test panels of the automatic flow switch testing system shall be wired and installed in sprinkler pump room or nearby plant room.

Where automatic flow switch testing system is not provided, the Contractor shall allow adequate drain points in the installation and connected to the nearest drain for routine testing of all flow switches in order to identify the conditions of sprinkler installation is operating properly .

B3.19 SUBSIDIARY STOP VALVES

Electric monitoring type subsidiary stop valves shall give visual signals back to the fire alarm control and remote indicating panel to identify the status of subsidiary stop valves at open/close state with padlocking facilities. Audible signal shall also be given when the valve is not in fully open position.

B3.20 SPRINKLER CONTROL VALVE SETS

The control valve set comprising the associated pressure gauges, valves, alarm devices, water motor gongs, testing facilities, retarding chambers etc. shall be in accordance with the LPC Rules for Sprinkler Installations. Electric monitoring device shall be fitted at each valve to give signals back to the fire alarm control and indicating panel to indicate the open/close state of the valve with padlocking facilities. Audible signal shall also be given when the valve is not in fully open position. Drain connection to the system shall be led to conspicuous positions as approved by the Architect and comply with the requirements of the Water Supplies Department. Sprinkler control valve set shall be of duplicate alarm valve arrangement or of alarm valve with bypass arrangement, and with alarm monitoring facilities.

B3.21 DRY PIPE INSTALLATION

Dry pipe installations shall be supplied and installed where specified or where the conditions are such that a wet pipe system cannot be used. For example, wet pipe installation cannot be used in premises where the temperature is artificially maintained close to or below 0^{o}C, such as in cold room, or in premises where the temperature is maintained or may be raised above 70^{o}C such as in drying room, and where the pipework cannot be run outside the cold or hot areas.

The installation shall be pressurized with compressed air within the pressure range as recommended by the alarm valve manufacturer and shall not exceed 400 kPa. A drop of the pressure to a predetermined value shall activate the installation dry alarm valve and primes up the sprinkler piping installation. Each installation shall be served by an independent compressed air supply system.

In cold room, automatic means shall be supplied and installed to automatically shut down the air circulation fans of cooling system when the sprinkler system operates. The Contractor shall co-ordinate with the parties for the installation of the cooling system and shall supply and install all necessary interfacing control, wirings, equipment and signals for shutting down the air circulation fans of the cooling system. The installation shall be fitted with upright sprinklers if the pipework runs in the cold room.

The compressed air-supply pipework shall consist of copper pipe or pipe of other approved materials. The compressed air-supply pipework shall be fitted with pressure relief valve, non-return valve, stop valve (normally open), suitably sized restrictor, and by-pass with stop valve (normally strapped and padlocked closed).

The compressed air-supply pressure-relief valve shall be set to relieve at a pressure of not more than 500 kPa in excess of the air pressure requirement of the installation dry alarm valve.

The compressed air-supply pipework shall be connected to the installation above the normal priming water level of the dry alarm valve.

With the installation valve primed in the ready position, it shall be possible to fully pressurize the installation in 1 hour, at any time.

Where recommended by the air compressor manufacturer, air compressors shall be equipped with automatic off-loading devices to depressurise the compressor prior to start up.

The compressed air-supplies to sprinkler installations in protecting the cold store shall be dried by passing through a suitable air dryer or freezer.

The restrictor in the compressed air-supply pipework shall be correctly sized to limit the mass flow of air from the air supply to the installation, so as to avoid delay of water discharge from the open sprinklers. Filter shall be supplied and installed at the upstream of the non-return valve and restrictor.

Restrictors shall be made from non-corrosive materials such as austenitic stainless steel or copper alloy having orifices with rounded edges.

Distribution and range pipes shall be of the terminal range configuration. Grid and loop configurations of pipework are not allowed.

A test facility shall be supplied and installed at the end of the hydraulically most remote range pipe on the installation, consisting of a 32 mm nominal diameter pipe and quick-acting test valve, with an outlet nozzle equivalent in size to the smallest sprinkler in the installation. The quick-acting test valve shall be located in an easily accessible position and shall be normally secured in the closed position with a suitable strap or chain. The end of the test line shall normally be capped or plugged.

Sprinkler installations in the dry-pipe mode shall either

(a) have an internal volume of air-filled pipe not exceeding: -

Light hazard	1.0 m^3
Ordinary hazard	2.5 m^3
High hazard	2.5 m^3

or

(b) discharge water from the testing facility within 60 seconds of activating the quick-acting test valve when the installation is in the normal stand-by condition.

The number of sprinklers on dry-pipe installations, including any tail-end extensions, shall comply with the LPC Rules for Sprinkler Installations.

B3.22 PRE-ACTION SYSTEM

Pre-action system shall be supplied and installed where specified. Pre-action system can be independent installations or subsidiary extensions. There are two types of pre-action systems as follows. Unless otherwise specified, Type 2 system shall be used for pre-action system: -

(a) Type 1 system - the system serves to prevent a premature discharge of water from pipework or sprinklers that have suffered mechanical damage. The water will normally flow into the pre-action pipework when both the sprinkler is opened and the fire detection system is operated. Sprinklers can be installed in the upright or pendent position; and

(b) Type 2 system - the system facilitates an early discharge of water from a dry pipe installation by opening the installation main control valve, thus filling the installation pipework with water, upon operation of a fire detection system. Consequently, the water shall fill the pre-action system pipework upon operation of a fire detection system before the sprinkler is operated. Sprinkler shall be installed in the upright position.

The pre-action sprinkler installation pipework shall be normally charged with compressed air under pressure as detailed in Clause B3.21, and monitored to give a warning indication on reduction of the air pressure. Complete loss of air pressure shall initiate the visual indication and audible alarm for a fire alarm.

The number of sprinklers in a pre-action system shall not exceed the following,

(a) In a light-hazard installation : 500 per installation.

(b) In an ordinary-hazard installation : 1000 per installation.

(c) In a high-hazard installation : 1000 per installation.

The pre-action system control panel shall incorporate the necessary relays, timers, key types switches, alarm and trouble lights essential to the operation of the system. The control panel shall employ printed circuit boards for the components and shall be completely factory-wired and ready for connection on Site. The control panel shall comply with clauses in Section B8 where relevant and the following,

(a) The capacity of the stand-by battery power supply shall be capable of operating the pre-action system for at least 72 hours. At the end of the 72-hour stand-by period, the stand-by power supply shall still be capable of operating the pre-action control panel and solenoid valve or actuator to release the pre-action alarm valve; and

(b) The pre-action control panel shall initiate operation of the pre-action alarm valve immediately in the event of a fire alarm system fault (including a failure of the primary and stand-by power supplies) which may result in failure to execute the appropriate actions in the event of fire.

The pre-action control panel relays and circuitry operating the pre-action alarm valve solenoid valves or actuator mechanisms shall be duplicated and wired such that no single fault or failure shall render the installation inoperable.

Monitoring devices shall be supplied and installed to give: -

(a) indication that any stop valves down-stream of the installation control valve set are fully open;

(b) audible and visual warnings at the pre-action control panel that any monitored stop valve is not fully open;

(c) audible and visual warnings at the pre-action control panel that the cover to a condition indicator switch has been removed;

(d) audible and visual warnings at the pre-action control panel of short circuit or disconnection of the leads of any solenoid valve or actuator which is energised to open;

(e) audible and visual warnings at the pre-action control panel of short circuit or disconnection of the primary power supply, the secondary power supply or any battery charger associated with the operation of the pre-action system.

The fire detection system used to activate a pre-action sprinkler system shall comply with LPC Rules for AFA Installations where appropriate and the following: -

(a) Each room or compartment protected by sprinklers shall have sufficient fire detectors to initiate release of the pre-action installation without the operation of any detectors external to the room or compartment or located within equipment;

(b) Fire detection systems employing coincidence connection (requiring a response from two detectors to initiate operation of the pre-action alarm valve) may be used with Type 1 and Type 2 pre-action installations. Consideration shall be given to actuate the pre-action alarm valve on operation of a single fire detector where fast-developing fires may occur;

(c) Any two detectors of a group of detectors that may initiate the operation of the pre-action alarm valve shall be separately connected to independent wiring circuits (coincidence connection);

(d) Consideration shall be given to the nature of the occupancy, building height, sprinkler thermal sensitivity, air movement and the recommendations of the LPC Rules for AFA Installations and the LPC Rules for Sprinkler Installations.

B3.23 RECYCLING SYSTEM

Recycling system shall be provided where specified and necessary for the following reasons: -

(a) to restrict water damage after a fire is extinguished;

(b) to avoid closure of the main installation stop valve if modifications are made to the installation pipework or if sprinkler heads are to be replaced;

(c) to prevent water damage caused by accidental mechanical damage of the installation pipework or sprinklers.

The complete installation including equipment, components and wiring shall be LPCB approved or approved by similar widely recognised independent regulatory body and accepted by the FSD. The control panel, batteries and charger, sprinkler heads, flow control, related auxiliary valves and compressed air supply system shall be supplied from a proprietary manufacturer specialized in the manufacture of the system. The installation work shall also comply with the recommendations of the manufacturer.

The major components of each recycling installation shall consist of, but not limited to, the following: -

(a) Recycling heat detector;

(b) Fire resisting detector cable;

(c) Control panel;

(d) Batteries and charger;

(e) Electric alarm bell;

(f) Pipework and fittings;

(g) Sprinkler head;

(h) Flow control and other auxiliary valves; and

(i) Compressed air supply system including air compressor, piping and fittings

All major components shall be LPCB approved or approved by similar widely recognised independent regulatory body as an integral part of the recycling installation. The complete recycling system shall be FSD approved or have been accepted by the FSD in past building projects.

(a) Heat Detector

The heat detector shall be a heat sensitive, normally closed, electrical detector which shall operate at a fixed temperature. It shall be rate compensating and feature automatic recycling. Each detector shall be complete with a tell-tale of zinc alloy. The detector units shall be connected with fire resist cable to the control panel. When a detector is heated to the temperature set point, a mechanical switch shall open and break the series circuit interrupting the flow of current. When the temperature drops below the set point, the circuit is re-established. It shall be able to be mounted at any angle. The heat probe shall be of stainless steel and the top shall be colour coded for temperature set point and spacing. The detector trip temperature shall be factory set and shall not be adjustable in the field. The detector shall be capable of withstanding at least 815^{o}C for short periods of time without damage. At sustained high ambient temperature above 420^{o}C, the tell-tale tab shall drop away indicating possible detector damage. The conduit box attached to the detector shall be fire and explosive proof and constructed of copper-free aluminium with threaded conduit connections and adaptors provided for detector cables.

The detectors should have a 60^{o}C detection rating, spaced less than 12 m apart and less than 6 m from walls, which can monitor up to a maximum of 149 m^{2} of area under optimum conditions of a smooth ceiling. Where approved by the Architect, exact requirements of the spacing, location, serving area, and provision of detectors shall be in accordance with the recommendation by the manufacturer of a proprietary recycling system acceptable to the FSD.

The detectors shall comply with the requirements in Clause B6.3 where relevant and applicable.

(b) Fire Resisting Cable

The whole re-cycling pre-action system shall be wired with low smoke fire resistant cables to BS 6387: 1994 Cat CWZ. The fire resisting cable shall consist of copper conductors and shall withstand 950^{o}C temperature for at least 3 hours. It shall be non-toxic, and no toxic or noxious fumes shall be emitted during a fire. It shall not allow a fire to propagate and no conduit shall be required. It shall be bent easily to match contours for easy installation. The cable shall be cut to length in field and may be spliced, but all splices must be made in conduit boxes which shall be flameproof and water proof.

The binding tapes used with the cables must be flame retardant.

The cables shall be installed in conduits, cable trays or other approved supports, and be properly fixed by approved fasteners or clamps specially designed and constructed for the purpose, to the satisfaction of the Architect.

(c) Mode of Operation

Water discharge cycling shall be controlled by heat detectors installed at the roof or ceiling which operate as an electrical interlock causing the water flow control valve to operate. A timer shall be supplied and installed to delay closure of the flow control valve for a predetermined period of at least 5 minutes in each cycle after lowering of the temperature of the heat detectors.

The fire alarm bell shall continue to sound until the reset button is pushed. Should the temperature rise to the tripping point of any detector during any phase of the cycle, the system shall continue the water flow or immediately start the flow of water to suppress the fire.

(d) Control Panel

The control panel shall be of FSD approved type and incorporate with all necessary relays, timers, key type switches, alarm and trouble lights essential to the operation of the system. The panel shall be completely proprietary product with factory-wired and ready for connection on Site.

The control panel shall control the re-cycling pre-action system and serve to operate as a cycling pre-action system with the electrical detection circuit in service or as a dry system without the electrical detection circuit in service. An ON/OFF indication light shall be incorporated to monitor the selection of the recycling ON/OFF switch. The control panel shall also incorporate a system tripped light and a low air pressure light. System operation or low air pressure shall activate the corresponding light and the audible trouble alarm and other alarms required which can be silenced by the ON/OFF switches.

Testing facilities shall be provided to simulate the opening of the detector circuit momentarily to cycle the system. A reset button on the panel shall reset the timer and alarm circuits after system operation.

The whole recycling installation shall be designed and constructed as a fail-safe installation. If the detector circuit and/or pressurized air are unavailable for service, the system shall turn into an ordinary automatic dry pipe or wet pipe system. All alarms except the low air pressure alarm shall operate constantly unless shut off and cycling features are negated.

(e) Flow Control Valve

The flow control valve shall be a quick opening, differential diaphragm valve with a spring loaded floating clapper. The flow control valve shall facilitate manual or automatic on/off control. It shall also be used to control water pressure or water flow rates. The flow control valve can be used as pressure reducing valve to limit or conserve water flow.

(f) Sprinkler Head

Where there is a danger of freezing, sprinkler head shall be installed in the upright direction. Otherwise, it can be installed in the upright or pendant position.

The number of sprinkler head shall not exceed 1000 per installation.

(g) Compressed Air Supply

Each recycling installation shall be supplied and installed with an independent compressed air supply system.

The air supply system for each of the recycling installation shall consist of an compressor, pneumatic actuators, air maintenance devices, pressure monitoring valves, controls, wiring, copper pipework and fittings, and all other necessary accessories for the operation of the system. The compressor shall be operated by means of air pressure switches installed on the main pipe. On detecting air leakage reduced to a predetermined value, the compressor shall automatically cut-in, and shall cut-out after the air pressure has been built-up adequately. The air leakage will actuate the alarm system as mentioned earlier.

The compressed air system shall allow the recharging of the recycling installation manually after the sprinkler system has been operated and the actuated sprinkler heads are replaced.

The compressor of the compressed air system shall be an oil-free, permanently lubricated type. It shall be of direct driven type with no belts or gears, and shall be compatible with air maintenance devices and other system components for effective operation, with no special source of air required. The compressor shall be complete with thermal protection, air filters, safety relief valve and other protective provisions.

The air maintenance device shall be an automatic, field-adjustable air maintenance provision for the compressed air system. It shall be equipped with pressure switch, restrictor check valve, strainer, bypass valve etc. for the optimum operation of the system, and to enable the compressor to be started under load. The device shall provide a balancing means to minimize on-off cycling of the compressor and the need to rapidly relieve the system pressure to the actuation point.

B3.24 DELUGE INSTALLATION

Deluge installation shall be supplied and installed where specified. The deluge system shall be designed to provide full protection in applying water over an entire area of protection. The deluge installation shall be fitted with open sprinklers and provided with devices for both manual release mode and automatic release mode. The automatic release shall be operated by a fire detection system in opening a deluge valve or energising multiple valve controls.

The Contractor shall check and verify the pipework sizing by hydraulic calculation and submit fully calculated results to the Architect for approval. The Contractor shall calculate and check the storage water tank requirements for the deluge system. All calculations shall be included in the submission to the FSD for approval.

B3.25 DRENCHER INSTALLATION

Drencher installation shall be supplied and installed where specified. Drencher system shall be designed to provide protection for openings, to separate an area of high fire risk such as in theatre stages with safety curtain provision, for exposure protection, to protect the marine filling station and to provide protection for the refuge floors to the approval of the FSD. The drencher installation shall meet with the relevant requirements in FSD Circular Letters, Code of Practice for Fire Resisting Construction, licensing requirements for places of public entertainment, and other relevant codes and licensing requirements.

Drencher system shall be designed to protect the surface area with water flow rate of not less than 10.0 l/min/m^2 protected surface area at all points on the protected surface or at a flow rate agreed by the FSD. This shall be checked and verified by hydraulic calculation or computer simulation with on site acceptance tests. The system shall be designed to comply with Rules of the Fire Officers' Committee (Foreign) for the Installation of External Drenchers, FSDCoP, FSD Requirements and Circular Letters.

Drencher system shall be actuated by an automatic fire detection system or sprinklers installed in the same area. A manual release device/system with operating instructions shall also be supplied and installed near the deluge valve.

Unless otherwise specified, sprinklers installed in the same area or pilot sprinklers, where provided, shall be used to actuate the drencher system. Where sprinklers are used to actuate the drencher system, the Contractor shall supply and install a separate local sprinkler flow switch with test facilities to the sprinklers installed in the same area as the drencher system, or to the pilot sprinkler system for actuating the drencher system. The location of the local sprinkler flow switch shall be selected such that actuation of the sprinklers in other area shall not cause the drencher system to operate.

The sprinklers for drencher actuation shall be of quick response type with a short Response Time Index (RTI) value suitable for the hazard to be protected. The RTI value shall be submitted for approval.

Where sprinkler system is not installed in the same area and where local sprinkler flow switch and pilot sprinkler system cannot be installed, heat detection system in coincidence connection shall be used to actuate the drencher system.

Smoke detection system could also be used where specified. Where the drencher system is used to separate an area of high fire risk for life safety protection or to protect a compartment forming part of an escape route as indicated or where specified, the drencher system shall be actuated by smoke detection system in coincidence connection.

Drencher system for refuge floor shall be actuated by heat detection system with coincidence connection where sprinkler system is not provided on the refuge floor.

For the detectors arranged with coincidence connection (cross-zone operation), the detectors shall be arranged each on either side of the drencher heads. The activation of one detector shall energise an alarm with visual and audible warnings on the control panel. The activation of any two detectors arranged in coincidence connection shall operate the drencher installation. Where required by the FSD and approved by the Architect, activation of the detectors provided solely for the drencher system shall not activate the general fire alarm and shall not send the fire signal via the fire alarm direct link and alarm transmitter.

The drencher heads shall be designed to provide an even sideward and downward throw of water to protect the whole vertical surface. The Contractor shall calculate the number of drencher heads, select the type of drencher heads, their separation and their arrangement to provide an even flow of water over the entire vertical surface of the openings protected by the drencher system. The Contractor shall take due consideration on the effect of wind and air movement in surrounding environment of the protected area in the design and selection of equipment for drencher system.

The Contractor shall check and verify the sizing of pipework by hydraulic calculation and submit fully calculated results to the Architect for approval. The Contractor shall calculate and check the size of the water storage tank which shall be adequate for not less than 30 minutes of operation of all the drencher installations that are required to be operated simultaneously. All calculations shall be included in the submission to the Architect and FSD for approval.

For safety curtain provision in stage and auditorium, the drencher shall be designed to provide a protection of not less than 1 hour FRP with the use of safety curtain. The water storage shall be enough for not less than 1-hour operation.

Where specified, foam drencher system shall be supplied and installed with quick response sprinkler heads for areas with special hazard.

B3.26 OTHER AUTOMATIC FIXED INSTALLATIONS USING WATER

The Contractor shall design, supply and install other automatic fixed installations using water where specified. This includes water mist system, water spray system, foam water system etc. All installation details and calculations shall be included in the submission to the Architect for approval.

SECTION B4

TANKS AND PUMPS

B4.1 WATER SUPPLIES

Water supplies for fire service installations and equipment shall be of types approved by the Water Supplies Department and the FSD.

B4.2 WATER TANKS

Water tanks forming part of the building construction will be provided by the Building Contractor unless otherwise specified.

Water tanks shall be constructed in compliance with FSDCoP, LPC Rules for Sprinkler Installations, FSD Requirements and Circular Letters, and the requirements of Water Supplies Department, the HKSAR.

Puddle flanges for inlet and outlet pipes shall be supplied by the Contractor and installed by the Building Contractor unless otherwise specified. All other piping connections and valves shall be supplied and installed by the Contractor except overflow, drains and inlet piping which will be supplied and installed by Building Contractor unless otherwise specified.

The Contractor shall check the construction drawings for water tanks for fire service installation and verify their correctness for installation purposes, or submit proposals for modification to the design, as necessary, and shall assist in the supervision of their construction, in order to ensure their suitability and proper functioning.

Where an independent private water consumption meter is not provided by the Building Contractor for water supply to the water tanks of fire service installation, the Contractor shall supply and install private water check meter(s) for the fire service installation and obtain approval of the WSD.

B4.3 WATER PUMPS

Water pumps for sprinkler systems shall comply with the LPC Rules for Sprinkler Installations. Sprinkler pumps shall be approved by LPCB or other similar widely recognised independent regulatory body acceptable by the Architect. Test certificate shall be submitted at the time of delivery. Details are in Clause B4.13.

Water pumps for hydrant/hose reel systems shall comply with FSDCoP, FSD Requirements and Circular Letters, and wherever applicable BS 5306-1: 1988. Pumps shall be manufactured by a manufacturer possessing certified ISO 9001:2000 quality assurance system.

There shall be at least one standby pump in addition to the duty pumps for each pump set. In addition, there shall be at least one jockey pump installed for each sprinkler pump set.

B4.4 PUMP OPERATION

Pumps with stable characteristics for fire service installation shall be selected to suit the design requirements for capacity (flow rate) as specified and shall discharge at a pressure which shall produce running pressures within the statutory requirements at the location concerned. In addition, the required net positive suction head of the selected pumps shall be compatible with the available net positive suction head in the installations. The design figures given on the Particular Specification and/or drawings are for guidance only. No adjustment in cost will be entertained if the actual required duty points (pressure and flow rate) are different from the specified figures. Close valve total pressure head shall not exceed 140% of the rated head.

The Contractor shall be responsible for carrying out a final accurate calculation of operating heads based upon the characteristics of the pipework systems including fittings, equipment and accessories as actually installed by him. Certified performance curves for the pumps shall be provided with the operating range clearly indicated.

The design speed for all fire services pump set shall not exceed 50 rps and the output power of each driving motor shall be rated to give 20% for hydrant system and 10% for sprinkler system more power in addition to the hydraulic power required for the rated system flow.

Pumps shall be capable of running under conditions of zero or low "draw-off" continuously without overheating. This may be achieved either by pump design or by an automatic by-pass circuit arrangement. Details of this function shall be shown on the Contractor’s Installation Drawings. Overheat alarm devices may be supplied and installed if necessary but these shall not be arranged to shut down the pump automatically.

Pumps shall have acceptable low noise level and good energy efficiency to the approval of the Architect especially for the jockey pumps.

B4.5 PUMP CONSTRUCTION

Pumps for fresh water pumping duties unless otherwise specified, shall be of one of the following types: -

(i) End suction type, the pump set shall be installed with spacer type coupling so that the pump impeller can be dismantled from the motor side for servicing without disruption of the pipe-work nor dismounting the motor, or

(ii) Horizontal or vertical spindle type centrifugal pump with end suction at the end or bottom.

Single stage pump shall be selected for system with high static pressure head. Multi-stage pump may be used only when suitable single stage pump is not available in the market and with substantiation submitted to and approved by the Architect.

Unless otherwise specified, the materials of construction and installation standard of the pumps shall be as follows or of better materials and approved by the Architect:

(a) Casing: Cast iron to BS EN1561 Grade 180;

(b) Impeller and guide rings: Stainless Steel to BS EN 10088-1: 2005 No. 1.4401 ground and polished. Renewable guide rings shall be bronze and shall be provided in the casing, keyed to prevent rotation;

(c) Shaft: Stainless Steel Stainless Steel to BS EN 10088-1: 2005 No. 1.4401 ground and polished;

(d) Sleeves: Stainless Steel Stainless Steel to BS EN 10088-1: 2005 No. 1.4401 ground and polished;

(e) Casing rings: Stainless Steel Stainless Steel to BS EN 10088-1: 2005 No. 1.4401 ground and polished;

(f) Shaft nuts: Bronze or better material;

(g) Mechanical Seal: Stainless Steel BS EN 10088-1: 2005 No. 1.4401 ground and polished. The Drain piping shall be connected to the nearest builder's drain for gland leakage. Mechanical seals shall be of leak free operation. The mechanical seal shall be the product of specialist proprietor and the materials used shall be suitable for the pumped liquid;

(h) Glands: Carbon steel or better material;

(i) Lantern rings: Stainless Steel BS EN 10088-1: 2005 No. 1.4401 ground and polished.

All connecting flanges of the pump shall be to BS EN 1092 -1: 2002, BS EN 1092 -2: 2002, BS EN 1092 -3: 2004, class PN16, or higher pressure rating as required. Taper pieces shall be provided where necessary. Shaft and Impeller(s) shall be statically and dynamically balanced after assembly. Impeller rings shall be of cast iron and renewable secured from relative movement by stainless steel end rotation ring.

B4.6 PUMP SET INSTALLATION

The pump and motor shall be directly coupled and mounted on a substantial machined base plate of cast iron or of fabricated mild steel. Couplings shall be flexible of steel pin and synthetic rubber bushing type, accurately aligned, and fitted with guards.

Pumps shall be complete with all necessary water seal connections, vents, drains and priming plugs, and all installation materials including foundation bolts and anti-vibration mountings. Drain pipework shall be of copper and shall run to a nearby drain gully or as specified. Automatic priming equipment shall be included where necessary to ensure that the pumps are primed at all times.

Each pump sets and the associated pipework shall be provided with automatic air valves, gate or butterfly valves, gauges (refer to Clause B1.15), strainers and check (non-return) valves etc. The drain vent shall be built-in complete with a drain plug except where the pump is inherently self-venting, the drain and drip connection valves and air cock shall be provided in accordance with Clause B1.13.

The exposed shafts, couplings and moving parts of pumps shall be provided with suitable galvanised iron mesh guards coated with primers and finishing paint and shall be stoutly constructed and easily removable complete with lifting handles.

Each pump shall be provided with pressure gauges installed to indicate the suction and discharge pressure. The gauges shall be neatly mounted on a rigid wooden or metal board adjacent to the pump or rigidly fixed in-line with suction and discharge pipework. Suitable permanent labels in English and Chinese shall be affixed for each gauge to indicate its function. The gauges shall be suitable for the system pressure ratings concerned and shall comply with Clause B1.15.

Duty/standby selector, manual start/stop buttons, voltmeters, ammeters, high/low level alarm, and associated indications shall be supplied and installed at the starter panel inside the pump room. Except the manual stop buttons, similar provisions shall also be supplied and installed at the main and/or repeating fire alarm control and indicating panels as specified in the Particular Specification. A lock-off type emergency stop shall be supplied and installed adjacent to each pump set. Visual and audible warnings shall be provided on the pump control panel indicating the pump is stopped and locked by the emergency stop and shall remain on until the emergency stop is reset. Except for the proprietary package pump set and proprietary starter panel of FSD approved type and manufactured with ISO 9001:2000 quality assurance system, the starter panel shall be made from minimum 1.6 mm thick stainless steel to BS EN 10088-1: 2005 No. 1.4401.

Means for starting the pumps manually shall be provided at the pump room adjacent to the pumps and on the fire alarm control and indicating panel.

B4.7 MAINTENANCE FACILITIES

Pump installation shall be complete with adequate facilities for maintenance and future replacement of base plate. Lifting eyes shall normally be provided upon pumps, motors, and engines. Details of any requirements for overhead run-ways, hoists etc., required for installation and maintenance shall be submitted to the Architect for approval. Where there is a Building Contractor carrying out the building work for a particular project, the overhead run-ways, hoists and hoisting beam will be carried out in the building work by the Building Contractor provided that the Contractor shall submit in good time to the Architect for approval, full details of such requirements, so that due consideration may be given before the Building Contractor commences work in the areas concerned. Where there is no Building Contractor, all facilities for maintenance shall be supplied and installed by the Contractor.

B4.8 MOTORS FOR PUMP DRIVES

Electric motor for pump drives shall be of the drip proof or totally enclosed fan-cooled (TEFC) squirrel cage induction motor to BS EN 60034-1: 2006, BS EN 60034-5: 2005, BS EN 60034-6: 1994, BS EN 60034-9: 2005, BS EN 60034-12: 2002, and BS EN 50347: 2001 with Class F insulation. Drip proof motors shall be fitted internally with an anti-condensation heater of single phase pattern arranged so that the heater will be switched off automatically when the motor is started and switched on automatically after stopping. Totally enclosed fan-cooled motors shall be dust and moisture protected to IP 54. In damp situations or in underground pump houses, motor terminal boxes shall be of weather-proof type. The power factor of the motor shall not be less than 0.85 lagging under all normal operating conditions. Noise level of all motors shall be in accordance with or better than the recommendation of BS EN 60034-9: 2005 and shall comply with Environmental Protection Department's requirements. Motor and pump shall be properly balanced and aligned to avoid excessive vibration.

B4.9 MOTOR STARTING

The method of motor starting shall be selected according to the characteristics of the pump and shall comply with the Electricity Supply Co.'s limitations on starting current. The type of starter shall be as follows, unless otherwise specified: -

<u>Condition 1 : For supply arrangement from company's overhead line</u>

Up to 3.8 kW	Direct-on-line
3.8 kW to 22 kW	Star/delta
Above 22 kW	Automatic-transformer 60% tapping or star/delta

<u>Condition 2: For supply arrangement from company's non-overhead line system</u>

Up to 11 kW	Direct-on-line
11 kW to 25 kW	Star/delta
Above 25 kW	Automatic-transformer 65% tapping or star/delta

B4.10 STARTERS

Starters shall be air break triple pole electromagnetic contactor type and shall comply with and be tested to BS EN 60947-4-1: 2001. Any no-volt release mechanism must be of the automatic resetting type such that on the restoration of the supply the motor can re-start automatically. Magnetic and thermal overload trips are not allowed. A phase failure protective device shall be incorporated. Utilization category shall be AC-3 of intermittent duty Class 0.1, 60% on-load factor. Each starter shall comprise on/off controls and indications.

Starters shall be supplied and installed complete with enclosures except where required to be mounted upon composite control panels and shall be in accordance with BS EN 60947-4-1: 2001. Enclosure shall provide protection of person against contact with live or moving parts inside the enclosure, protection against ingress of dust and liquid and protection against mechanical damage in accordance with BS EN 60947-1: 2004, BS EN 60947-4-1: 2001.

Starters shall be capable of making and breaking currents without failure under the conditions in BS EN 60947-4-1: 2001 for the required Utilization category and the number of operation cycle. The main contact of a starter shall be sliver or sliver-faced.

Starters shall comply with the requirements for performance under short-circuit conditions stipulated in BS EN 60947-4-1: 2001. Type of co-ordination shall be Type 1.

Star/delta and auto-transformer starters shall have approved timers for automatic transition, calibrated and adjustable.

All components shall be of non-hygroscopic, non-corroding material and tropicalised. Operating coils shall be wound on nylon or similar and vacuum impregnated with non-organic varnish or plastic encapsulated.

B4.11 PUMP SET ISOLATION MOUNTINGS

Unless otherwise approved by the Architect, motor driven pump set shall be mounted upon a common base plate supported by approved spring-type isolation mountings on concrete plinth. Where package fire pump set is specified, the fire pump, motor, couplings, controls etc. shall be pre-assembled on the common base plate with spring type isolation mountings by manufacturer in a factory possessing ISO 9001:2000 quality assurance system. The bases of the pump set shall be mounted on the raised housekeeping plinth using appropriate anti vibration spring mountings that shall be individually selected according to load distribution and shall have an additional free travel equal to one half of the rated deflection.

B4.12 JOCKEY PUMPS

Jockey pumps complete with TEFC driven motor for maintaining hydraulic pressure shall be of the multi-stage horizontal or vertical centrifugal type having construction generally in compliance with Sections B4.5 and B4.8 with stainless steel shaft and impellers. Alternatively, reciprocating pumps capable of performing the same duty may be acceptable. Reciprocating pumps shall be with stainless steel piston rod and piston, synthetic rubber seals and oil bath lubrication, mounted on a common base plate with the electric motor drive. Motor efficiency of jockey pumps shall comply with Code of Practice for Energy Efficiency of Electrical Installation issued by Electrical and Mechanical Services Department, 2007 Edition and all subsequent amendments, except for pump motor which is component of approved package equipment.

B4.13 FACTORY TEST AND CERTIFICATION

All sprinkler pumps before delivery shall be factory tested and certified on the performance. Factory test certificates and records shall be submitted to the Architect. Where the manufacturer does not have an approved test facilities required by the LPCB for the test in the factory, the Contractor shall, before delivery, arrange the test to be carried out by an independent testing organisation approved by the LPCB or a widely recognised approved independent regulatory body acceptable to the Architect. On-site test will not be accepted as a substitute for the factory test or the test by the independent testing organisation. Test certificates endorsed by the independent testing organisation shall be submitted to the Architect for approval and record.

Package fire pump set shall be factory tested and certified with all test details same as the sprinkler pump.

Where specified, factory test and certification shall be provided for other pumps adopting the same requirements as the sprinkler pump.

SECTION B5

GASEOUS EXTINGUISHING SYSTEM

B5.1 GENERAL

The Contractor shall be responsible for the design of the gaseous extinguishing system to meet with the requirements in this General Specification and the design intent shown in the Drawings.

Gaseous extinguishing systems shall be of the total flooding type with pressurized open-ended piping installation on the distribution side. The automatic gas release mechanism shall be operated by means of fire detection units at the protected compartment or manually by a pull handle or push button as described.

The gaseous extinguishing system shall be designed to comply with the standards published by National Fire Protection Association (NFPA), British Standards or other internationally recognised equivalent standards acceptable to the Architect and demonstrated to be equivalent in terms of the type of construction, functions, performance, general appearance and standard of quality of manufacture and approved by the Architect. All proprietary design details from the manufacturer shall be submitted to the Architect and the FSD for approval.

Gaseous extinguishing system shall use carbon dioxide, clean agents or other gases as approved or as specified in the Particular Specification.

Carbon dioxide system shall be designed and installed in accordance with BS 5306-4: 2001, or NFPA 12: 2005, and shall only be used in normally unoccupied areas where egress of personnel can be accomplished in 30 seconds.

Other gaseous extinguishing systems shall use clean agents unless otherwise specified. The system shall be designed and installed in accordance with NFPA 2001: 2004, BS ISO 14520: 2006 or other recognised established system design manual published by the manufacturer and acceptable to the Architect. The system shall also comply with UL 2166: 1999 and UL 2127: 1999 as relevant.

Where the agent for the gaseous extinguishing system is not specified in the Particular Specification and Drawings, the Contractor shall use 1,1,1,2,3,3,3-heptafluoropropane (HFC-227ea) for the gaseous extinguishing system.

For installation in areas with high ceiling height, low temperature or with limitation in the storage spaces for the clean agent cylinders making the use of HFC-227ea unsuitable, the Contractor may propose to use other clean agents such as HFC23, inert gas etc. together with detailed manufacturer's recommendation and calculation submitted for approval by the Architect. Additional submission, tests and endorsement by the FSD may be required for the use of other clean agents. All the cost for such submissions and tests to the approval of the FSD and the Architect shall be borne by the Contractor.

The gaseous extinguishing system shall be a proprietary product approved by the LPCB, UL or FM and has been accepted by the FSD for use in buildings in Hong Kong in past projects. All components of the installation shall be compatible with the design of the system. Any add-on device shall be approved by the system manufacturer and shall not affect the proper functioning of the system.

The system shall be designed in according to an engineered computer programme approved by a recognized approving organisation as listed in the FSD Circular Letters or accepted by the FSD, or alternatively, the system shall be of modular or pre-engineering type and installed in accordance with the manufacturer's specifications.

B5.2 QUALITY OF EXTINGUISHING AGENTS

Carbon dioxide shall be of good commercial grade, free of water and other contaminants that might cause container corrosion or interfere with the free discharge through nozzle orifices. In general, carbon dioxide obtained by converting dry ice to liquid will not be acceptable. The vapour phase shall not be less than 99.5% purity with no detectable off-taste or odour. The water content of the liquid phase shall not be more than 0.01% by weight. Oil content shall not be more than 10 ppm by weight.

Clean agents shall comply with NFPA 2001: 2004 or BS ISO 14520: 2006, in particular, the acute toxicity, the ozone depletion potential and global warming potential.

All extinguishing agents should be supplied from approved local or overseas agencies/suppliers authorised or recognised by the proprietary manufacturer. The Contractor shall be required to provide documentary evidence when required by the Architect. The Architect may also require the content and composition of the extinguishing agents to be tested and verified by an approved independent testing laboratory before installation. All cost shall be borne by the Contractor.

B5.3 PERFORMANCE OF STANDARD TOTAL FLOODING INSTALLATION

Carbon dioxide total flooding systems shall be designed to achieve the necessary concentration, rate of application and duration to maintain the extinguishing concentration as specified in BS 5306-4: 2001 or NFPA 12: 2005 in accordance with the volume, hazard and environmental conditions of the protected enclosures. The rate of application shall comply with following requirements: -

(a) For surface fires, the design concentration shall be achieved within 1 minute; and

(b) For deep-seated fires, the design concentration shall be achieved within 7 minutes but the rate shall not be less than that required to develop a concentration of 30% in 2 minutes.

Clean agent gas flooding system shall be designed to achieve an acceptable concentration in the protected compartment as stipulated in NPFA 2001: 2004 or any recognised system design manual from the manufacturer at room temperature. Discharge of gas shall be substantially completed within 10 seconds. Following discharge, the concentration of clean agent shall develop throughout the protected compartment to achieve final extinguishment of fire within 60 seconds.

B5.4 CONTRACTOR'S RESPONSIBILITY FOR SYSTEM PERFORMANCE

The compartment to be protected and the location of the gas cylinders shall be as indicated on the Drawings or as approved. The layout of pipework and nozzles shown on the Drawing is indicative. The Contractor is responsible for the design of the complete system in co-ordination with other services.

Notwithstanding the Contractor has demonstrated by calculation to the satisfaction of the Architect that the system will perform to the standard required, the Contractor shall remain responsible for ensuring that under test the system does in fact perform in accordance with the Specification.

B5.5 DESIGN CALCULATION

To justify the selection of components and pipe sizes for the system, the Contractor shall include in the submission, the manufacturer's system design manual and calculation for the pre-engineered system; or either full mathematical calculation or computer modelling flow calculation for the engineered system. Where the computer programme does not show all the calculation steps, the Contractor shall produce evidence that the computer programme produces a design that will perform in accordance with the Specification and the relevant standards.

The calculation shall be based on the equipment offered. Valves, siphon tubes, distribution valves as well as bends and junctions shall be represented in the calculations as equivalent lengths of pipe. The actual size and location of pipes and nozzles and the number of nozzles shall be designed on the basis of the calculated flow rates and terminal pressures required to ensure successful operation. The calculation or computer programme shall provide all the information necessary to complete the installation including the total quantity of gas required to flood to the required concentration with allowance for losses, the flow rate, start and end pressure of each section of pipe and the orifice size for each nozzle.

The calculation shall show that the design concentration can be achieved and that the maximum allowable concentration shall not be exceeded at all conditions.

B5.6 CONTRACTOR TO PROVIDE A COMPLETE WORKING SYSTEM

The Contractor shall supply and install all the components necessary for full operation of the system in the automatic or manual mode regardless of whether such components are specified or not.

B5.7 GAS STORAGE PRESSURE

All the extinguishing agents shall be stored in rechargeable cylinders to hold the pressurised agents in liquid form at ambient temperature. The Contractor shall select cylinders of commonly available sizes and types that can be recharged. Each gas cylinder shall be sized to have spare capacity to hold at least 10% more gas extinguishing agent than the amount calculated in the design for fire suppression. The gas cylinder is however not charged with 10% more gas extinguishing agent than the requirement.

For high-pressure carbon dioxide system, it shall be pressurised to a corresponding nominal pressure of 5860 kPa at 21°C. The normal filling density shall not be in excess of 68%. For low-pressure carbon dioxide system, it shall be kept at the design pressure of 2068 kPa by refrigeration system. The refrigerant in the refrigeration system shall have zero ozone depletion potential. Appropriate alarm and pressure relief shall be supplied and installed to cater for possible failure of the refrigeration system. Unless otherwise specified, high-pressure carbon dioxide system shall be used.

Clean agent cylinders shall be charged in accordance with NFPA 2001: 2004 or any recognised system design manual from the manufacturer.

Gas cylinders, distribution pipework, valves, nozzles and fittings shall be manufactured to standards designed to withstand the maximum pressure of stored agent allowing for variations in ambient temperature.

The gas cylinders shall be FSD approved and designed for the intended gas storage pressure and use. A copy of the approval of the gas cylinders by the FSD shall be submitted.

B5.8 GAS CYLINDERS

Carbon dioxide cylinders shall be of seamless steel construction to BS EN 1964-1:2005. For low-pressure refrigerated system, it shall be in accordance with the manufacturer's design and approved by recognised bodies such as LPCB, UL, FM or approved by any similar widely recognised independent regulatory body acceptable by the Architect and the FSD.

Clean agent cylinders shall be constructed in accordance with NFPA 2001: 2004.

Cylinders shall be securely mounted in a frame bolted to the wall and to be so arranged that the external parts may be readily inspected and avoid corrosion. Each cylinder shall be fitted with an automatic pressure release device for over pressure protection of the cylinder.

Each cylinder shall be complete with gas valve, actuator, pressure gauge, flexible hose, check valve and all other necessary accessories. Where the cylinder of a proprietary system accepted by the FSD is not fitted with a pressure gauge, the Contractor shall supply and install pressure gauge in the system pipework for each cylinder.

A device shall be supplied and installed for measuring the amount of liquid in the cylinder at any time. This shall be done by a method which does not require the cylinder to be detached from the manifold. If a weighing device of the type that requires suspension is proposed, means shall be supplied and installed above each cylinder for the attachment of the weighing device. The contents of the cylinders may alternatively be checked by the use of a liquid level indicator of a type approved by the Architect.

The liquid shall be discharged from the cylinder through a siphon tube. The pressure of the liquid stored in the cylinder shall be such that freezing cannot take place at the lowest possible ambient temperature.

Means shall be supplied and installed to prevent gas discharging into empty containers and to prevent loss if the gas is released when any of the cylinders is disconnected.

Gas cylinders shall be painted signal red as specified in BS 381C: 1996 in accordance with the requirements of BS 5252: 1976. The cylinder shall be free from all rust and corrosion before painting is applied. The type of extinguishing agent, the tare weight, gross weight, liquid level at 21°C and also the degree of super pressurisation (for clean agent) where applicable shall be clearly painted on each cylinder with white paint.

Gas cylinders shall be of rechargeable and re-usable types. If the discharge of gas will require the irreversible rupture of any component of the system such that they are not reusable, the Contractor shall provide one spare set of such components for each installed cylinder. They shall be stored in a labelled and locked cabinet inside the gas cylinder room. Three keys shall be provided.

The gas cylinder shall pass the pressure tests before filling with gas. Relevant test result shall be submitted to the FSD. The Contractor shall submit a copy of approval document from the FSD for the gas cylinders to the Architect at the delivery of the gas cylinders.

The Contractor shall supply only gaseous extinguishing system that can be recharged locally and that the refilling of gas after discharge can be accomplished within a short time. The Contractor shall submit details of the refilling arrangement including agency, address of local workshop, refilling time etc. together with the equipment submission to the Architect for approval. Equipment submission without details on the refilling arrangement shall not be approved.

The Contractor shall supply and install facilities to isolate or to lock the gas cylinders during routine maintenance or inspection work on the gas cylinders and control system in order to prevent accidental discharge of gas. The facilities shall give appropriate warning indication when it is switched to the 'isolated' mode.

B5.9 FIRE DETECTION AND SYSTEM CONTROL - AUTOMATIC RELEASE

Fire detection in the protected area shall be by means of smoke or heat or multi-sensing detectors as specified. Sufficient detectors shall be supplied and installed to give duplicate coverage of the whole of the protected area and connected in cross-zones. The fire detection control panel and the detectors shall be compatible with each other and the fire detection system shall comply with clauses in Section B6.

Activation of a detector on one zone shall cause alarm bells to sound. Activation of detectors on two zones shall cause a siren or an approved horn to sound and red or amber flashlights in the protected area to light warning that the extinguishing agent is about to be discharged if the system is in the automatic mode. These warning signals will also be activated by the operation of the manual release before the discharge.

The gas extinguishing control panel shall control and monitor the gas release system. It shall include an automatic/manual lock-off unit controlled by key switches at EACH entrance to the protected area. The operation of key switch at these locations shall be capable of switching the system on or off. The manual release mechanism will remain operative whether the system is on or off. A time delay unit which is adjustable in the range of 15 to 30 seconds shall be supplied and installed. Relays shall be supplied and installed to shut down ventilation/air-conditioning control system, to close openings and to switch off equipment as necessary. These relays will operate immediately when two zones of the fire detection system are activated or when the manual release is operated. Release of the gas will follow after the pre-set time delay.

The gas extinguishing control panel shall comply with clauses in Section B8 where relevant and with battery backup. The battery supply shall be able to actuate the system at the end of the standby period.

B5.10 MANUAL RELEASE

A manual release unit shall be supplied and installed in a suitable position outside each entrance to the protected compartment. The manual release unit shall consist of a pull handle or push button mounted in a box with "break glass" cover. The box shall be so designed that its glass front may be readily replaced and that its front cover can be opened with a key for the purpose of operating the switch without breaking the glass.

B5.11 EMERGENCY RELEASE

An emergency release handle with direct mechanism shall be supplied and installed in an accessible position at or near the gas cylinders. The emergency release shall require no power supply to operate and it shall be supplied and installed with a removable pin to prevent accidental release of gas. Provision shall be made for operation of the emergency release to activate the relays to cause simultaneous shutdown of ventilation, air-conditioning, equipment etc. and to sound the alarm.

B5.12 GAS RELEASE MECHANISM

The operation of the gas release mechanism shall require minimum power from an external electrical, pneumatic or mechanical source and shall preferably be operated by a falling weight device. No springs shall be used in any position where their failure, or fracture would prevent the correct operation of the gas release mechanism or cause the inadvertent release of the gas.

All release devices and mechanisms shall be designed for the working conditions they will encounter and shall not readily be rendered inoperative or susceptible to accidental operation. They shall have proper protection from mechanical, chemical or other damage that would render them inoperative.

B5.13 GAS DISTRIBUTION SYSTEM

All pipework shall be non-combustible and able to withstand the expected pressures and temperatures without damage. Specification of materials and installation shall conform to the relevant international standards for the respective extinguishing agent used.

Pipes for high pressure open-ended carbon dioxide system shall be as follows: -

Up to and including 40 mm:	Heavy galvanised steel pipe to BS EN 10255:2004 / ISO 65:1981 butt welded or products having equivalent functions or performance
50 mm and up to and including 150 mm:	Electric resistance and induction welded carbon steel pipe to BS EN 10217-1: 2002 Schedule 80 with grade of steel 410 or ASTM A106/A106M: 2006 Grade A hot finished or cold Schedule 80

Pipes for clean agent system shall be as follows: -

Pipes to be used shall conform to the following relevant standards or NFPA 2001: 2004 or approved products having equivalent functions and performance or that recommended by the manufacturer for an approved proprietary system for a particular gas extinguishing system in accordance with the pipe size and pressure of the system. Special attention shall be paid, in particular, to the maximum allowable pressure for pipes and the minimum piping requirements.

ISO 65:1981 (BS EN 10255:2004), heavy grade	Screwed and socketed steel tubes and tubular and for plain end steel tubes suitable for welding or for screwing to ISO 7-1:1994 (BS EN 10226-1:2004) pipe threads
BS EN 10217-1: 2002 Schedule 80 with grade of steel 410 or, ASTM A106/A106M, grade A hot finished or cold schedule 80	Carbon steel pipes and tubes with specified room temperature properties for pressure purposes
ASME B31.1	Power piping
ASTM A53/A53M: 2006	Specification for welded & seamless pipe

Pipe fittings to be used shall conform to the following relevant standards or NFPA 2001: 2004 or approved products having equivalent functions and performance or that recommended by the manufacturer for an approved proprietary system for a particular gas extinguishing system in accordance with the pipe size and pressure of the system. Special attention shall be paid, in particular, to the maximum allowable pressure for pipes and the minimum piping requirements.

BS 3799: 1974	Steel pipe fittings screwed and socket-welding for the petroleum industry
BS 1640-3: 1968-3	Steel butt-welding pipe fittings for the petroleum industry: wrought carbon and ferrite alloy steel fittings
BS EN 10241: 2000	Steel threaded pipe fittings
BS 143 & 1256: 2000	Malleable cast iron and cast copper alloy threaded pipe fittings

BS EN 1759-1: 2004	Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories, class-designated. Steel flanges, NPS 1/2 to 24
ASME B31.1	Power piping
ANSI B1.20.1: 1983	Standard for pipe threads, general purpose
ASTM A53/A53M: 2006	Specification for welded & seamless pipe

Other standards adopted for proprietary systems that have been accepted by the FSD can also be used when approved by the Architect

Pipes up to 100 mm shall be screwed and socketed, pipework over 100 mm shall use screwed flanges.

Threaded steel pipework and fittings shall be free of burrs and rust and shall be galvanised inside and outside. Screwed threads shall conform to the dimensions specified in BS EN 10226-1: 2004. Screwed joints shall be made with P.T.F.E. tape or approved products having equivalent functions and performance but chemically inert to the extinguishing agent used. Compressed fibre gaskets free of asbestos shall be used for flange joints. Pipe work shall be painted signal red as specified and illustrated in BS 381C: 1996 in accordance with the requirements of BS 5252: 1976. Brass fittings shall be left unpainted.

Pipework supports shall be arranged as near as possible to joints and changes of direction and each support shall take its share of the load. The maximum space between supports to take into the total mass of pipe and extinguishing agent shall be as follows: -

Table 2 : Minimum spacing of pipework supports for gaseous extinguishing system

Pipe size (mm)	15	20	25	32	40	50	80	100	150	200
Span (m)	1.5	1.8	2.1	2.4	2.7	3.0	3.6	4.2	5.2	5.8

Additional supports shall be supplied and installed where there are extra loads such as valves, where required by the Architect and where recommended by the manufacturer.

Discharge nozzles shall be of robust construction and designed for use with the expected working pressure and temperature without deformation. The discharge orifices shall be made of corrosion resistant metal and have a permanent marking for identification and to show the equivalent single orifice diameter.

Flexible hose connections shall be selected, inspected and tested only by an engineer or technician suitably trained and shall be designed for service at the pressures and temperatures involved.

To prevent entrapment in pipework, a suitable excess pressure relief valve shall be supplied and installed at any section of high pressure piping blocked by valves at both ends and shall operate at the following pressures: -

Carbon dioxide high pressure system:	15 MPa ± 5%
Clean agent extinguishing system:	2 times the maximum system pressure

Valves shall be capable of being opened when subjected to the maximum operating pressure and shall be so equipped that they can be opened manually. Valves for carbon dioxide system constantly under pressure shall be designed for a working pressure of 19 MPa. Valves for other clean agents shall be designed for maximum working pressure plus a 50% safety factor.

Manifolds shall be tested for duration of minimum 5 minutes at the manufacturer's works to the following minimum pressure: -

Carbon dioxide high pressure system:	19 MPa
Clean agent extinguishing system:	2 times the maximum system pressure

Pipework shall be earthed to prevent building up of to electrostatic charge.

Gas nozzles shall be of approved type and appropriately spaced in accordance with the manufacturer's design manuals. Gas nozzles shall be supplied and installed in all voids and spaces to be protected by gas flooding in accordance with manufacturer's recommendation and as approved by the Architect and the FSD. The Contractor shall submit calculation or manufacturer's manual to substantiate the nozzle spacing.

B5.14 GAS DISCHARGE SYSTEM TO BE SECURELY FIXED AND GUARDED

The gas discharge system including cylinders, pipework and nozzles shall be securely fixed to the structure with correctly spaced saddles or brackets in according with the FSD Requirements and Circular Letters. All components shall remain in place when subjected to the pressures and forces produced during discharge. Fixings shall allow for movement due to thermal expansion.

The system shall be guarded so that the operation of any moving parts shall not be obstructed.

B5.15 INDICATOR LIGHTS, WARNING NOTICES AND LABELS

All gas storage compartments and compartments protected by a gas extinguishing system shall have a warning notice fixed on each entrance door to the compartment. Configuration, lettering, colour and size of the notice shall be in accordance with the FSD Requirements and Circular Letters for the respective gas extinguishing system. The notice shall be made of sheet metal plate not less than 1.6 mm thick or of material approved by the Architect.

For a total flooding system, protecting a normally occupied area, which is designed to operate automatically when unoccupied but to be in the manual mode when occupied, the following warning lights shall be installed together with explanatory/warning notices in English and Chinese. Such notices shall be clearly legible and painted or engraved on sheet metal plate or on substantial durable material approved by the Architect. Warning lights and notices for systems other than as described above, e.g. local application systems or systems designed to be in the automatic mode when the area is occupied, shall be equally informative and suitably substantial and shall be arranged and worded either as specified or as agreed with the Architect.

Inside the protected area, a flashing red light to indicate gas release imminent with a notice which shall read: -

"WARNING - *** gas release imminent. Leave the room at once."

Outside each entrance to the protected area: -

(a) a green light to show that the system is on manual control with automatic control locked off, with a notice which shall read: -

"Safe to enter. *** fire extinguishing system on manual control. When room vacated switch to automatic control".

(b) an amber light to show that the system is on automatic control, with a notice which shall read: -

"Not safe to enter. *** fire extinguishing system on automatic control. Switch to manual control before entering".

(c) a red light to show that the system has operated, with a notice which shall read: -

"DANGER - Do not enter. *** gas discharged".

*** denotes the extinguishing agent.

The manual/automatic lock off key switches, the manual release units and the emergency release handle shall all be labelled in English and Chinese so that it is clear what their purpose is and how to operate them.

B5.16 SYSTEM ODORISER

Odorisers where specified shall be capable of automatically treating the gas after releasing from the cylinder and shall be of citrus odour type, so that hazardous atmosphere can be recognised at once. Where odorisers are installed, a suitable notice to the effect that anyone detecting the citrus odour should leave the area immediately and report the occurrence to a responsible person. The notice shall be worded in English and Chinese.

B5.17 ROOM CONDITION

The Contractor shall co-ordinate with relevant parties to check the exhaust requirements for the room after the discharge of gas extinguishing agent and shall submit the requirements on additional facilities if the exhaust provisions are not adequate to meet with the relevant safety standards or that recommended by the manufacturer. Where specified, the Contractor shall supply and install exhaust facilities and fans recommended by the manufacturer for removing the gas after discharge. Unless otherwise specified, the Contractor shall supply and install approved dampers, curtains and other approved products having equivalent functions and performance to shut off all room openings/door louvers/air ducts as shown on the Drawings during the discharge of gas.

The Contractor shall check and provide calculation to show that the rooms designed with gaseous extinguishing system can maintain the design concentration for the period required in the NFPA Standard. Where necessary, the Contractor shall conduct test such as door fan pressurization and depressurisation test to establish the data on room leakage rate. Any works leading to a high leakage rate not complying with the requirements of the FSD shall be reported to the Architect when such works are provided by others.

The Contractor shall allow carrying out on-site full discharge test after completion of the installation when required by the FSD and in accordance with the FSD's requirements to confirm the design conditions can be met. The Contractor shall refill the gas cylinders after the discharge test.

B5.18 OTHER AUTOMATIC FIXED INSTALLATIONS OTHER THAN WATER

The Contractor shall design, supply and install other automatic fixed installations other than water where specified. Details shall be submitted to the Architect for approval.

SECTION B6

MANUAL AND AUTOMATIC FIRE ALARM SYSTEM

B6.1 GENERAL

Performance at fire and reliability are two key requirements in the selection of equipment. The Contractor shall supply and install highly reliable approved manual and automatic fire alarm systems that have a good record of 'no false fire alarm' and 'no malfunctioning' in the past years. Substantiation on a good record of reliability shall be obtained from the suppliers and submitted to the Architect. System that has a poor false alarm record or has failed to provide the required record when asked will not be accepted for the Works. Only equipment that suits the operating environment shall be selected and used.

Manual and automatic fire alarm initiating devices shall be appropriately sited to avoid factors that can generate false fire alarms.

At locations where the relative humidity is higher than 95% continuous non-condensing such as in non-air-conditioned space, the Contractor shall use detectors of harsh type or of appropriate design specially made for harsh environment and high humidity application up to relative humidity 99% continuous non-condensing.

At dusty or windy environment, appropriate filtering and shielding devices shall be added to the detectors. At external area or covered area that can be subject to rainwater at wind condition, waterproof equipment shall be used. Appropriate type of surge protective device shall be supplied and installed in the electrical and control circuits for suppression of over-voltage surges arising from lightning strikes and switching transient.

Manual and automatic fire alarm system shall be of analogue addressable type except for system with manual fire alarm only.

The rate of false fire alarms, excluding false fire alarms arising from malicious actions by humans and false fire alarms with good intent involving genuine belief of a fire, shall not be more than one false fire alarm per 100 fire alarm initiating devices per annum for all fire service installations in a building, and shall not be more than one false fire alarm per 80 automatic detectors per annum for the automatic fire alarm system. The Contractor shall be responsible to limit the false fire alarms in the process of equipment selection, choosing suppliers, types and brands, whole system integration, installation, siting, testing, commissioning, cleaning/maintenance, and verification of manufacturer's test records and quality control standards. The Contractor shall only select brands and models of equipment and materials that have good track record or job reference of meeting the above requirement on the rate of false fire alarms.

B6.2 MANUAL CALL POINT

Manual call point shall be of "break-glass" type complying with BS EN 54-11: 2001, or a type approved by the Architect. Electrical contacts shall operate automatically upon breaking of the frangible element at the front of the unit. The cover shall be locked in position with a special key and the frangible element shall be clipped firmly into place.

The unit shall be of pleasing appearance and styling, constructed of non-combustible and corrosion resistant materials, and finish enamelled red. The words: "Fire: Break Glass 火警鐘掣" shall be suitably engraved or embossed in English and Chinese on the front.

Contacts shall be of silver or approved non-deteriorating alloy of normally-open or normally-closed type to suit the alarm system. A concealed "test" device shall be included. The voltage and current ratings of the contacts shall be marked in the unit.

Call points shall be of flush semi-recessed mounting or surface mounting type as specified and suitable for direct connection to the wiring system of the type specified therein without the addition of unsightly surface boxes, glands, adapters etc. Where special boxes are necessary for installation of the call points in a conduit system, the boxes shall be supplied and installed by the Contractor. Boxes recessed in concrete or plaster shall be of galvanised steel.

Terminals for external conductors shall be provided in the unit for connection of at least two conductors of size not less than 1.5 mm^2 each. When the call point is intended for use at voltage in excess of extra low voltage, it shall have suitable means for providing earth continuity between external circuits connected to it.

Call point located at outdoors or at a location subject to possible rainwater due to occasional strong winds and other intermittent factors shall be of waterproof type to IP67 as the minimum. Waterproof call point shall be provided at all locations with risk of water damage even when the risk is not high. The corresponding conduit to the call point shall run through an additional box installed below the call point to prevent the possibility of water running inside the conduit enter the call point directly.

Where the call point is located in hazardous area, explosive zone and dangerous good store, the call point shall also comply with Clause B6.8.

Generally, manual call points shall be fixed at a height of 1.15 m above finished floor level unless otherwise required to comply with the universal accessibility best practices. They shall be surface mounted, or semi-recessed, in order to present a side profile area of not less than 750 mm^2.

Manual call points shall be provided at all escape routes and in particular at each hose reel point, all storey exits and all exits to open air. Additional call points shall be provided where specified in the Particular Specification or Drawings.

Manual call points shall be of addressable type when analogue addressable manual and automatic fire alarm system is provided.

B6.3 HEAT DETECTOR

Heat detector shall be of point-type complying with BS EN 54-5: 2001. Heat detector shall be LPCB approved type or approved by similar widely recognised independent regulatory body.

Heat detector shall be of Class A2 complying with BS EN 54-5: 2001:2001 with combined fixed temperature and rate-of-temperature-rise, except as specified or where necessary to suit the actual environment of the space being protected. Class BR or CR heat detector as appropriate to suit the operating environment shall be provided for pantry, domestic kitchen and specified space where rapid increases in temperature can be experienced under normal operating condition. Class CS, DS, ES, FS or GS heat detector, depending on the maximum application temperature, shall be provided for boiler room, commercial kitchen and specified space where under normal operating condition, high ambient temperature and rapid changes in ambient temperature may be experienced.

Heat detector shall function correctly at ambient temperature between -20^{o}C to the maximum application temperature specified in BS EN 54-5:2001 for respective class. Heat detector shall be designed to assume minimum protection rating of IP 43. It shall be suitable for stable operation in the Hong Kong climate where high humidity condition may exist at location without constant air-conditioning. The Contractor shall submit manufacturer's printed catalogue or other certification proving that the heat detector in non-air-conditioned space is suitable for operation under relative humidity up to 99% continuous non-condensing, and in air-conditioned space relative humidity up to 95% continuous non-condensing, in the Hong Kong climate.

Heat detector shall be of analogue addressable type. Heat detector unit shall be of flush or surface mounting type as specified in the Particular Specification. Heat detector unit in suspended ceilings shall be flush mounted and shall, in the case of modular constructed ceilings, be co-ordinated into the ceiling layout.

Installation of heat detector shall be in accordance with the LPC Rules for AFA Installations. Heat detector shall be mounted not less than 500 mm away from any walls or partitions and not less than 25 mm or more than 150 mm below the ceiling or roof. In open areas under flat horizontal ceilings, the horizontal distance between any point in the area and the nearest point-type heat detector shall not exceed 5.3 m.

Where the type of detector is not specified, heat detector shall be used in electrical/switch room, utility/plant room, kitchen, non-air-conditioned space/area/void, basement, car parks, semi-open/open area, cold store, lift shaft, riser ducts etc. unless otherwise specified and except in areas where smoke or multi-sensors detectors are required to satisfy FSD Requirements and Circular Letters such as installation for sleeping risk, for smoke management, for ventilation/air-conditioning control system, etc.

B6.4 SMOKE DETECTOR

Point-type smoke detectors include ionisation smoke detector, optical (photoelectric) smoke detector, multi-sensors detector, duct type smoke detector and other approved point-type smoke sensing devices. Smoke detector shall be LPCB approved type or approved by similar widely recognised independent regulatory body.

Smoke detector shall be of proprietary design to avoid false fire alarms. The Contractor shall supply and install smoke detectors that have good track record or job reference on no false fire alarm.

Smoke detector shall function correctly at continuous ambient temperature between 0^{o}C and 48^{o}C, relative humidity up to 99% continuous non-condensing in non-air-conditioned space and relatively humidity up to 95% continuous non-condensing in air-conditioned space unless otherwise specified. Where smoke detector is installed in low temperature zone with temperature less than 10^{o}C continuous or in high temperature zone with temperature higher than 40^{o}C continuous, smoke detector designed for a wider operating temperature range shall be provided. Smoke detector shall be suitable for stable operation in the Hong Kong climate where high humidity condition may exist at location without constant air-conditioning. The Contractor shall submit manufacturer's printed catalogue or other certification on the maximum and minimum application temperature and humidity range of the smoke detector. Smoke detector shall have minimum protection rating of IP 43.

Smoke detector shall be housed in a corrosion-proof plug-in unit designed to mount pendent, surface or semi-recessed as specified. Removal of the unit from its base shall cause a fault alarm signal to be given. Sensitivity shall be adjustable by means of a pre-set control only accessible by use of a special tool or in the central fire alarm control system.

Smoke detector shall be of analogue addressable type. The system shall have automatic drift compensation provision and remote adjustable sensitivity setting to cater for different environment.

Smoke detector shall be provided with built-in wind-shield to ensure that air currents of up to 10 m/s do not affect the proper operation of the detector. A built-in wire mesh shall be incorporated to prevent entry of insects into the interior. Static shielding shall be built in and included to protect against the operation interference of electrical noise.

Smoke detector installed inside lift shaft and outdoors shall be completed with extra wind-shield to cater for higher air current and shall also be of harsh type with anti-condensation facilities designed for higher temperature fluctuation, relative humidity and dirt accumulation.

The electronic circuitry shall be of solid-state type, operating at extra low voltage DC. The quiescent current consumption of the unit shall be minimal and shall not exceed 50 μA at 24V. The circuitry shall be protected against electromagnetic interference. The internal electronic circuitry shall be of highest possible reliability and protected against voltage spikes and surges. The smoke detector shall be capable of operating satisfactorily under variation of ±25% minimum in supply voltage.

Smoke detector shall have normal working life (mean failure time) of not less than 10 years. The Contractor shall submit documentary evidence from the manufacturer or from an independent widely recognised regulatory body approved by the Architect certifying the normal life span of the detector.

Installation of smoke detector shall be in accordance with the LPC Rules for AFA Installations. A low-profile design smoke detector that protrudes no more than 60 mm from the ceiling shall be used in all air-conditioned areas with false ceiling. Point-type smoke detector shall be mounted not less than 500 mm away from any walls or partitions and not less than 25 mm or more than 600 mm below the roof or ceiling. In open area under flat horizontal ceiling, the horizontal distance between any point in the area and the nearest detector shall not exceed 7.5 m.

Use of smoke detector in area vulnerable to false fire alarm shall be avoided where possible if it shall comply with the FSD Requirements and Circular Letters. Heat detectors will be preferred in such case if it will comply with the requirements.

Smoke detector where specified and without the type stated shall be multi-sensors type detector except in area having high risk of fast growing fire with colourless smoke. Ionisation smoke detector or optical smoke detector shall only be used where specified or at the approval of the Architect or as required by the FSD. However, where ionisation smoke detector is the most suitable detector for a particular application, the consideration on performance at fire shall take priority over the reliability factor and ionisation smoke detector will be the choice in such case.

Smoke detector installed in cold store and in non-air-conditioned space/area/void including basement, plant room, car park, open area, concealed/false ceiling, raised floor, external area, lift shaft, and riser ducts shall be of approved harsh type designed to stand for extreme or hostile environmental conditions. Smoke detector of harsh type shall also be provided in dusty area and in area where the relative humidity is likely to exceed 95% non-condensing.

Where there is no smoke or heat point-type detector suitable for the environmental condition of a particular application, the Contractor shall use special detection system or other systems approved by the Architect.

For smoke detector installed in the air duct, duct type smoke detector with probe units of approved type shall be provided.

Where there are two or more smoke detectors installed in a zone or fire compartment, the Contractor shall wire the smoke detectors in cross-zoned operation (coincidence connection) unless otherwise specified. The activation of any one smoke detector shall initiate a fire alarm with audible alarm and visual indication on the control panel only and shall at the same time activate a time delay unit which is adjustable in the range from 0 second to 5 minutes or as approved by the Architect. If the alarm still exists at the end of the time delay period and/or the second smoke detector in the coincidence connection is activated, the building fire alarm shall be activated and the fire signal shall be sent via the fire alarm direct link and the alarm transmitter as appropriate. The setting of the time delay period shall be agreed by the FSD.

Smoke detectors installed solely for drencher system, fire shutter, fire door, and fire/smoke curtain provided for the purpose of fire compartmentation shall be connected in cross-zoned operation and shall only be operated with fire alarm when any two detectors in coincidence connection are activated. Activation of one detector shall give visual and audible alarm indication on the control panel only. Transmission delay unit shall be provided so that operation of two detectors in coincidence operation shall not send the fire signal to the FSD until after a pre-determined time delay. The setting of the time delay period shall be agreed by the FSD. When required by the FSD, activation of detectors provided solely for the above systems shall not activate the building fire alarm and shall not send the fire signal to the FSD via the alarm transmitter and fire alarm direct link.

Different types of smoke detectors shall also comply with the requirements specified hereunder.

B6.5 IONISATION SMOKE DETECTOR

Ionisation smoke detector shall comply with BS EN 54-7: 2001.

Where ionisation smoke detector of harsh type is specified, the ionisation smoke detector shall be specially designed to function correctly at extreme or hostile environmental conditions including large accumulation of dirt/dust, high wind speed, extreme temperature and high humidity (up to 99% relative humidity), and approved by the Architect. Anti-condensation facilities shall be included in the detector of harsh type as necessary to cope with high humidity.

Ionisation smoke detector shall be of the type responding to both visible and invisible products of combustion. Detector shall have not less than two ionisation chambers, one for detection and one for reference. Detector having only one ionisation chamber will not be accepted. Radiation level from the radioactive isotopes shall be within the safety limit of less than 0.1 mr/h at a distance of 100 mm. The combined radiation activity of each ionisation smoke detector shall not exceed 555 kBq in commercial/industrial buildings and 370 kBq in residential building.

The Contractor shall submit the total Americium 241 radiation level of all the ionisation smoke detectors installed in building to Hong Kong Radiation Board for approval on behalf of the Employer as necessary before the completion of the Works and the commencement of the Maintenance Period. The Contractor shall also make arrangements for inspection of the Works by the authorised representative(s) of the Hong Kong Radiation Board when required.

The Contractor shall limit the total radioactivity from all the detectors installed in building to below 20Mbq and shall use detectors with low radioactivity approved by the Architect to meet with this requirement.

In the case that ionisation smoke detector with lowest practical radioactivity is used and the total radioactivity from all detectors in building still exceeds 20Mbq, the Contractor shall make submission to the Hong Kong Radiation Board for obtaining the licence on behalf of the users before the completion of the Works and the commencement of the Maintenance Period, unless the building is exempted from such licensing requirement as informed by the Hong Kong Radiation Board or the Architect.

Ionisation smoke detector shall have built-in signal integration feature to avoid false fire alarm caused by transient interference and be characterised by a reversible response time delay from 15 to 30 seconds depending on the concentration of smoke continuously present before an alarm is initiated. Upon clearance of the transient interference within the time delay, the ionisation smoke detector shall resume its quiescent state without any alarm initiation.

B6.6 OPTICAL SMOKE DETECTOR

Optical (or photoelectric) smoke detector shall comply with BS EN 54-7: 2001.

The optical smoke detector shall respond to the product of combustion based on photo detection of light scattered in a forward direction by smoke particles. The detection chamber shall consist of a horizontal optical bench housing an infra-red emitter and sensor arranged radically to detect forward scattered light. The sensor shall be of silicon DIN photo diode or better design. The emitter shall be infra-red light emitting diode. The sampling and confirmation frequency shall not be less than once every 10 seconds and 2 seconds respectively. At least three consecutive sensed alarm signals shall be needed to trigger detector alarm. The detector shall have built-in devices or labyrinth arrangement to prevent false fire alarm due to an exterior high-energy light sources.

B6.7 MULTI-SENSORS DETECTOR

Multi-sensors detector shall comprise a combination of heat sensor, optical/ionisation smoke sensor, flame sensor, carbon monoxide sensor, ultraviolet/infrared sensors, and/or other sensors as recommended by the manufacturer to suit a particular fire risk and growth of fire. Multi-sensors detector shall comprise at least one smoke sensor and one heat sensor. Unless otherwise specified, the smoke sensor shall be optical smoke sensor type. The heat sensor shall be combined fixed temperature and rate-of-temperature-rise type.

Multi-sensors detector shall be FSD approved type and approved by the Architect. Only multi-sensors detector suitable for the required application, environmental condition, fire growth characteristic, fire risk and hazard shall be selected and used. The Contractor shall submit performance data, equipment catalogue, technical details, software algorithm, test report and certificate to the Architect for approval. The Contractor shall submit information proving suitability of multi-sensors detector for a particular application and hazard for approval.

Multi-sensors detector shall process inputs from more than one sensor using software algorithm that equate signals into pre-determined responses to react to defined environmental condition. One sensor can "check" with the other to confirm or deny the existence of a fire.

Multi-sensors detector shall have no more than four sensors. Through integration of signals from different sensors by software algorithm, multi-sensors detector shall be capable of providing reasonable response both for the fast growing fire and the slow developing smouldering fire. Multi-sensors detector shall be analogue addressable type. Individual sensor can be programmed to be disabled for some periods of time when required.

The design operating life of multi-sensors detector shall be at least 10 years. The Contractor shall submit documentary evidence from the manufacturer to demonstrate the operating life of multi-sensors detector.

B6.8 PROBE UNIT

Duct type smoke detector with probe unit shall be provided for smoke detector installed for the air duct. Probe unit for air duct insertion mounting shall be of robust corrosion-proof construction and capable of accurately sampling the air flowing in the duct over a wide range of velocities. Insertion of the probe shall cause negligible air flow head loss. Probe unit shall be designed to suit the type of smoke detector installed. Probe unit shall be installed in the centre of a straight section of air duct that has a length at least 6 times its width. The probe unit shall be supplied and installed with filter and the filter element shall be designed such that it can be removed for routine cleaning without the need of removing the probe unit and it does not cause the detection system to raise a false fire alarm.

Where duct type smoke detector is provided to air ducts in area vulnerable to false fire alarm for ventilation/air-conditioning control system, two duct type smoke detectors fed by the same or separated probe units shall be provided and connected in coincidence (cross-zoned) operation as agreed by the FSD and approved by the Architect. Activation of one detector shall give visual and audible alarm indication on the control panel only, and the ventilation/air-conditioning control system and building fire alarm shall only be actuated when two detectors in coincidence connection are activated.

B6.9 INTRINSICALLY SAFE DEVICE

Manual call point, heat detector, smoke detector, multi-sensors detector and other detectors installed in hazardous areas including explosive gas and dust environment shall be intrinsically safe type or comply with BS EN 60079-14 or BS EN 50281-1-2 as appropriate as required by the FSD Requirements and Circular Letters.

Intrinsically safe heat detector shall be supplied and installed in Cat 2, Cat 5 and appropriate categories of dangerous good stores, fuel oil tank rooms etc.

The intrinsically safe devices shall be factory certified to Ex ia IIC T5 complying with marking EX ia IIC T5 to IEC 60079 or approved products having equivalent or better functions and performance for use with all listed gases. The certification shall cover the entire system and components and shall be approved by a widely recognised independent regulatory body approved by the Architect. Intrinsically safe devices shall also comply with BS EN 50014: 1993, BS EN 50020: 2002 and IEC 60079 where relevant.

The operation of intrinsically safe manual call points, heat and smoke detectors shall be as specified in Sections B6.1 to B6.8. Remote red LED indicator shall be provided and factory certified for use with the detector. Each intrinsically safe circuit shall be restricted to a single zone and connected as a radial connection from the automatic fire alarm panel. Each circuit shall be provided with a "translator" and a safety barrier. The "translator" shall translate the system voltage to a level compatible with the intrinsically safe requirements and to boost the current pulses returned by the manual call points and detectors back to the panel. The "translator" shall be installed outside the hazardous area and within the safe area. Certification of the "translator" is not necessary.

A safety barrier shall be supplied and installed at the boundary of the hazardous and safe areas to stop the transmission of transient and fault interference from the system circuit into the intrinsically safe circuit. Unless otherwise specified or approved, the safety barrier shall be of single channel 28 V/300 Ohm type. The safety barrier shall be completed to a high integrity safety earth by duplicate (two) copper cables, each of cross sectional area of 4 mm^2 or greater. The impedance of the earth connection from the connection point to the main power system earth shall be less than one ohm. The safety barrier shall be certified to Ex ia IIC.

Each safety barrier shall not be connected to more than one intrinsically safe circuit in the hazardous area. The circuit shall not be connected to any other electrical circuit. The circuit in the hazardous area shall be installed in separate conduit and wiring system. The circuit shall be capable of withstanding a 500 V rms A.C. test voltage for at least 1 minute. The manual call points, detectors and LED indicators shall be installed in such a way that all terminals and connections are protected to at least IP 20 when they are mounted on the bases.

B6.10 ALARM BELL

Alarm bells shall be of minimum 150 mm diameter gong suitable for 24 V DC operation. They shall comply with BS EN 54-3: 2001. Each alarm bell shall be capable of producing a minimum sound level of 80 dB(A) at 3 m. The bell shall consist of a micro motor as the driving unit offering high performance and reliability together with low current consumption and low starting voltage characteristics. The bells shall be painted red and labelled "FIRE ALARM 火警警鐘" in both English and Chinese.

The alarm bells shall produce an alarm sound level complying with BS 5839-1: 2002 in all accessible parts of the buildings when the doors of the rooms are closed. The alarm sound level shall be not be less than 65dBA, and not less than 5dBA above any background noise likely to persist for a period longer than 30s when the building is in use, at a point anywhere in the building or in the case of domestic building at three metres from the main entrance door of the most remote flat with all doors shut except in areas not required by the FSD. A higher alarm sound level of minimum 75 dBA is required for sleeping accommodation. High power alarm bells shall not be used. The alarm sound level at all accessible locations 3 m or farther away from the alarm bells shall not exceed 120 dBA.

The alarm bells shall be sited and distributed throughout the buildings to produce the alarm sound level. The alarm bells where shown in the Drawings are the minimum requirements only. The Contractor shall provide adequate and additional alarm bells to meet with the sound level requirement. Before installation, the Contractor shall submit calculation on the alarm sound level to the Architect for approval. The alarm bell sound level at different locations shall be tested and verified on completion of installation work.

The alarm bells shall be zoned such that only alarm bells in the pre-determined zones shall sound. The zoning of alarm bell shall be in accordance with the FSD Requirements and Circular Letters and to the approval of the FSD and shall be submitted to the Architect for approval. In general, zoning of fire alarm is for the phased evacuation in large building and in premises supervised by trained staff. It depends on many factors including type and height of building, provision of sprinkler system, presence of refuge floors, and separation between occupancies. For large building, the Contractor shall submit details of the proposed alarm zoning for approval by the FSD and the Architect when such are not indicated on the Drawings.

Alarm bell shall be addressable type when used with analogue addressable manual and automatic fire alarm system.

Where specified, alarm bell shall be capable of generating two different alarm tones, one intermittent tone for alert and one continuous tone for evacuation, that can be programmed, either on a zoned basis or common system basis.

B6.11 VISUAL ALARM UNIT

Visual alarm unit shall be supplied and installed in places within building that are accessible to the public and where manual fire alarm system is provided. Visual alarm signal shall be in the form of flashing light conforming to NFPA 72: 2007: National Fire Alarm Code, or in accordance with Section 17 of BS 5839-1: 2002 as approved by the Architect. The strobe light shall consist a xenon flash tube or similar and associated lens/reflectors system. Unless otherwise approved by the Architect, the flashing light shall be red.

The strobe shall be designed for one flash per second with continuously applied minimum voltage and providing a light output of not less than the requirements in NFPA 72: 2007 or as approved. The light output shall also not be so high as to cause difficulty in vision due to glare. The strobe shall have no measurable in-rush current in excess of the operating peak current. The Contractor shall select visual alarm unit of appropriate light intensity and to position the unit such that at least one of them can be seen at any part of the building accessible to the public. The minimum rating of a visual alarm unit shall be 15 cd minimum.

The number of visual alarm units and their positions if shown on the Drawings are indicative only. The Contractor shall supply and install adequate number of visual alarm units to comply with FSD Requirements and Circular Letters including FSD Circular Letter No. 4/2001, and approved by the Architect at no additional cost. There shall be at least one visual alarm unit above or at a position as close as practical to every hose reel point and alarm point. Every compartment shall be provided with at least one visual alarm unit. Where the number of visual alarm unit can be reduced by using unit of higher light intensity and accepted by the FSD, the Contractor shall submit details for approval by the Architect. In general, the distance between two visual alarm units shall not be more than 60m.

The unit shall be mounted at a height not less than 2.1m above the floor but not closer than 150mm to the ceiling.

The unit shall be suitable for surface or semi-flush mounting and labelled "FIRE ALARM 火警" in both English and Chinese. The height of English letter and Chinese characters shall not be less than 10 mm and 15 mm respectively. They can be indicated on separate plate affixed nearby or engraved on the light cover.

Where more than one visual alarm units are supplied and installed in a room or in a common compartment, they shall be arranged to operate in synchronisation.

Back up emergency power supply and battery supply shall be supplied and installed for the visual alarm units similar to the fire alarm bells.

B6.12 ALARM INDICATOR LAMP FOR DETECTOR

Detector shall have a built-in alarm indicator lamp to be easily visible for identification of the detector giving off the alarm until the alarm condition is reset. The alarm indication shall be by means of a red LED or LED which emitting red light during alarm state.

Unless otherwise accepted by the Architect, the LED indication shall be designed for 360^{o} viewing or with two built-in LED indicators for each detector so positioned that at least one LED indicator can be seen from any angle. Remote LED indication may be added to substitute one of the built-in indicators when approved.

The indicator lamp shall be visible from a distance at least 6m directly below the indicator in an ambient light intensity up to 500 lux.

Detector installed inside false ceiling and in concealed space shall have remote alarm indicator lamp connected and mounted at ceiling level directly below or near to the concealed detectors with label for identification. The remote alarm indicator lamps shall be conspicuous from any position in the nearby area.

Where detectors are installed inside plant rooms, electrical equipment rooms, store rooms, dangerous good stores etc. which are unoccupied and normally kept locked, similar remote indicator lamps shall be supplied and installed above the doors outside the rooms to show the alarm status. If there is more than one detector inside the room, the indicator lamps can be connected to a common remote indicator lamp mounted above the door outside the room.

B6.13 MOUNTING BASE

Detachable detector shall be provided unless otherwise specified. For detector installed at easily accessible height in public circulation area, detachable detector shall not be used without the approval of the Architect and shall be provided with means to guard against theft when required.

The mounting bases shall be designed to enable detectors to be plugged in with a simple clockwise motion without significant insertion force. Where detectors are mounted at level above 4 m, they shall be capable of being removed and re-fixed from below by means of an extended arm special tool. Removal of individual detector from the mounting base shall not affect the operation of other alarm devices in the system.

A remote monitoring system shall be provided for detachable detector to detect the removal of the head from the mounting base to give a fault signal.

The detector shall be polarity insensitive, so that identification of the positive and negative lines connection in the mounting base is not necessary except when connecting to remote alarm indicator lamps.

The mounting base shall be able to accommodate different types of detectors of the same series from the same manufacturer and products from compatible suppliers. Any type of detector heads of the same series including heat, smoke, multi-sensors, fire, etc. shall be interchangeable and fit into a common mounting base. Unless otherwise specified or approved, all types of detectors supplied in a building shall be of the same series from one manufacturer.

B6.14 TEST FACILITIES

The end of line tester for each circuit of a conventional fire alarm system shall be located at high level or concealed inside ceiling void but shall be easily accessible. The tester shall be flush mounted type with stainless steel plate surface marked with engraved characters indicating the function.

Provision shall be made so that individual detector can be tested without either sounding an alarm or requiring the complete system to be disabled to prevent such an alarm.

B6.15 INTELLIGENT ADDRESSABLE DEVICE

All devices in the addressable fire alarm system shall be of analogue addressable type, and of type approved by the Architect, including the detectors, manual call points, flow switches, pressure sensors etc. where appropriate.

Each device/detector shall be addressable via a mechanism approved by the Architect. The address of each unit shall be easily set and changed. The allowable address shall be adequate to cater for the whole fire alarm system with ample spare capacity for future expansion. Dip switch type address setting mechanism is generally not preferred. Unless otherwise approved by the Architect, the address setting mechanism shall be attached to the base of the device/detector so that the device/detector head can be changed and replaced without the need to re-set the address. The device/detector shall constantly verify against the database in the addressable fire alarm control and indicating panel detailed in Clause B8.4 via an addressable detection cable loop.

Addressable devices shall provide information for continuous monitoring and control of detector status and annunciate the need for immediate service. The decision on the control actions shall however be from the fire alarm control system and not on individual detector. Connection wires for the addressable devices shall be of approved type by the Architect. Unless otherwise specified, twisted pairs in concealed conduits for point-to-point connection shall be used.

Detector shall be fully compensated for temperature, humidity and barometric changes in the surroundings. All electronic components shall be hermetically sealed to prevent their operation from being impaired by dust, dirt, humidity, corrosion or mechanical shock. All circuitry must be protected against typical electrical transients and electromagnetic interference according to BS EN 60801-2 / BS EN 61000-4-1 / BS EN 61000-4-3 / IEC 801-3. The termination shall be so designed that the terminals are polarity insensitive. Built-in testing facility shall be provided.

One LED indicator designed for 360^{o} viewing or two built-in LED indicators shall be provided for each detector unless otherwise accepted by the Architect and they shall be so positioned that at least one LED can be seen from any angle. Remote LED indicator may be added to substitute one of the built-in LED indication requirement when approved. The detector shall have provisions to drive remote visual alarm indicator. Remote indicator shall be compatible with the detector so that the operation of the indicator shall not affect the brightness of the detector's built-in LED.

(a) Addressable Heat Detector

In addition to the requirements stated in Clause B6.3, addressable heat detector shall continuously measure the temperature of air and generate a proportional analogue output.

The detector shall employ two matched thermal sensing elements in a bridge configuration to give a response which depends both on temperature and the rate of change of temperature. The reference and sensing thermal sensors shall be fabricated under identical conditions to ensure good matching and excellent tracking with both temperature and ageing.

(b) Addressable Smoke Detector

In addition to the requirements from Sections B6.4 to B6.8, addressable smoke detector shall continuously measure the products of combustion in the air and generate a proportional analogue output.

The measuring chamber shall be so designed to create a very low background signal in clean air condition. A specially designed device shall be incorporated to control dust settlement on non-critical surfaces so that high dust level in the surroundings can be tolerated.

(c) Addressable manual call point

The addressable manual call point shall be of a type approved by the Architect.

The addressable detectors (heat, smoke or others) shall be provided with the following features as a minimum: -

(a) Remote adjustment of detector sensitivity to suit the occupancy and/or the environment of a detector at any time;

(b) Sensor monitoring with automatic compensation of sensor alarm threshold due to aging, humidity and accumulation of dirt and dust with time (automatic drift compensation);

(c) Adjustable time lag from the time of reaching alarm threshold to the time of issuing or communicating a fire alarm (pre-alarm, alarm verification);

(d) Different alarm levels are provided such as detection level, maintenance or regular servicing level, fire alarm level etc. to give an early warning for maintenance to avoid false fire alarm (multi-sensitivity levels, day/night adjustment, and maintenance alert);

(e) Alarm condition simulation for testing purpose; and

(f) Loop monitoring for error such as short circuit, open circuit, detector removed and detector communication failure (auto detector test, circuitry test).

B6.16 ADDRESSABLE INTERFACE MODULE

Various modules shall be provided for the addressable automatic fire alarm system for the required functions, interfacing with non-addressable devices and other services. Modules shall be mounted into junction boxes for easy installation. The addresses of these modules shall be easily set, seen and changed.

The module shall have a conspicuously located LED, which blinks or does not blink, upon being scanned by the panel. Upon determination of an alarm condition, the LED shall be latched on and blink or not blink as assigned.

(a) Monitor Module

Monitor module allows the panel to interface with and monitor individual non-addressable monitoring alarms such as a non-addressable manual call point, sensors, detectors, water flow switches, sprinkler supervisory devices etc.

The module shall provide addressable inputs for all N.O. or N.C. contact for continuous monitoring. In addition to the supervised state of the monitored device, the measurement of the supervision shall be sent to the addressable automatic fire alarm control and indicating panel.

The monitor module shall also provide a supervised initiating circuit. An open-circuit or short-circuit fault shall be indicated at the fire alarm control and indicating panel.

Facilities shall be provided for carrying testing at the monitor module during maintenance and diagnostics.

(b) Control Module

Control module supervises and monitors wiring to appliances of small connected load like alarm bells, flashing light units, indicator units, and interface relays. Upon command from the addressable automatic fire alarm control and indicating panel, the module shall disconnect the supervision and connect the external power supply to the device and a signal shall then be sent to the panel to indicate that the command was executed. The external power shall be isolated, so a trouble condition at the power supply shall not interfere with the rest of the system.

The connected alarm load shall be closely monitored for any open and short circuit conditions. The output circuit connected to the loading shall be short circuit protected.

(c) Fault Isolator Module

The non-addressable fault isolator module shall detect and isolate a short-circuited segment of a fault-tolerant loop whilst allowing the rest of the addressing circuit to function normally.

At least one fault isolator module shall be provided for every 20 intelligent addressable devices, i.e. detectors, monitor modules and control modules to limit the number of devices lost in the event of a short circuit.

(d) Facilities for interfacing with any other systems as shown on the Drawings or as specified in the Particular Specification.

B6.17 SPECIAL DETECTION SYSTEM

Special detection systems, including optical light beam smoke detection system (complying with BS EN 54-12: 2002), VESDA (very early smoke detection alarm system), line-type heat detection system, flame detection system (complying with BS EN 54-10: 2002), aspirating smoke detection system (complying with BS EN 54-20), carbon monoxide detection system, gas detection system, infrared detection system, ultraviolet detection system, video smoke detection system, dust detection system etc. shall be provided where specified or where required to meet with the requirements for a particular application. The detection system shall be of a type acceptable to the FSD and approved by the Architect. Selection of special detection system shall be to suit a particular application, environmental condition and fire hazard. The Contractor shall submit detailed performance data, equipment catalogue, description, technical information, test report and certificate to the Architect for approval. The Contractor shall submit information proving the suitability of the special detection system for approval.

SECTION B7

AUDIO/VISUAL ADVISORY SYSTEM

B7.1 GENERAL

The Contractor shall design, supply and install the audio/visual advisory system and the selection of proper, correct and compatible equipment and components to achieve the performance specified. Detailed design layouts as well as full technical information and calculations for the system shall be submitted to the Architect and the FSD for their approval prior to ordering and installation.

The equipment and components offered shall be proven proprietary products with good quality for accomplishing the safe evacuation of occupants in the premises during a fire risk condition and to the acceptance of the Architect. They shall be operated at not more than 90% of the manufacturer's specified ratings. They shall be fully tropicalised and suitable for continuous operation with optimum performance in ambient temperature between 0^{o}C and 40^{o}C and with relative humidity up to 99% continuous non-condensing as normal condition, and also in fire conditions.

In selecting makes and types of equipment, the Contractor shall ensure that servicing facilities and replacement spare parts can be made available locally for future maintenance of the system.

In the event that these requirements cannot be met due to the use of improper, incorrect or incompatible components, the Contractor shall replace all such components and shall re-design the whole system all to the satisfaction of the Architect. All extra costs thus incurred shall be borne by the Contractor.

The audio/visual advisory system shall comprise coloured lights, flashing lights, illuminated and coloured signs, directional signs, low-level directional signs, microphones, amplifiers, cassette decks, loudspeakers and other accessories for providing indication to the exit routes and exits and for delivering verbal or direct transmission of emergency messages to the occupants.

Audio/visual advisory system shall be supplied and installed to all areas and places controlled and classified under Places of Public Entertainment Ordinance, Cap 172 and to other areas as required in FSD Requirements and Circular Letters.

B7.2 AUDIO SYSTEM

The audio system shall be designed and installed in accordance with the FSD Requirements and Circular Letters and BS 5839-8: 1998. The system shall also comply with the General Specification for Electrical Installation, the General Requirements for Electronic Contracts issued by the Electrical and Mechanical Services Department, the General Technical Specification for Public Address

System issued by the Electrical and Mechanical Services Department, BS EN 60849: 1998 / IEC 849 and BS EN 60268.

The design of the system shall be such that special attention is paid to the following points: -

(a) System reliability and fail-safe;

(b) System damage caused by defective appliances and components;

(c) System feedback of sound level of operation for audio signals;

(d) Adequate output levels; and

(e) Variable input levels.

The audio system shall be designed to ensure matching between amplifier and load. The variation in available power shall not exceed 3 dB between the outlet nearest to the amplifier and any other outlet in the system. Suitable and acceptable repeaters and signal conditioner shall be installed as necessary to maintain the sound power level. A load variation of 50% shall not affect the quality of sound or cause the output voltage at any outlet to vary by more than 6 dB.

The audio system shall be provided with pre-amplifier and amplifier of sufficient power to drive all the loudspeakers and other equipment in the system. Each pre-amplifier and amplifier shall have a 100% standby unit, so arranged that if any one unit failed, the corresponding standby unit shall take up the duty for the respective operation automatically within fifteen (15) seconds. The system shall be so wired and arranged as to achieve this function.

(a) Desktop Microphone

Desktop microphone shall be single zone type complete with condenser microphone on gooseneck for use with the amplifier. It shall complete with a minimum of 1m length cable and a plug.

(b) Amplifier

Amplifier shall be fully transistorised solid state device. They shall have sufficient power with at least 10% spare capacity to drive all the speakers within the broadcasting zone.

The rated power output of each amplifier shall have a regulation from no load to full load of 2 dB. The amplifier shall have an audio response level to within +2 dB from 50 Hz to 14 kHz at full output, and the total harmonic distortion shall not exceed 1% at full load.

The noise level of each amplifier shall be at least 40 dB below maximum output with all inputs and outputs correctly terminated. Sensitivity shall be such that full output can be obtained from a 2 mV microphone or equivalent input.

Amplifier shall maintain a damping factor of not less than three over the frequency range of 100 to 5,000 Hz. Amplifier shall have a low hum level and low over-shoot or ringing when a square wave generator is connected to the input level within the working range. The variable tone control shall provide attenuating of the high frequencies, i.e. 0 - 20 dB at 8 kHz.

Amplifier shall be of constant voltage output type not requiring dummy load to maintain matching of the amplifier output. The output shall be provided with an overload protection device to prevent damage to the output stage from overload or a short circuit on the speaker lines.

The signal incoming leads shall terminate at the rear of the amplifier through suitable screened type plug mountings. Where more than one input is required, a screwdriver adjustment shall be provided at the rear for each additional input for preset balancing of the inputs. Input sockets and output terminals shall be well separated and in separate cut-outs in order to prevent coupling between the amplifier input and output.

Preamplifier shall be provided with connection to power amplifier, microphone, CD deck and cassette deck. It shall have built in On/Off switch, headphone outlet and volume control for each channel. An LED VU meter shall be provided to indicate the output level.

For single broadcasting zone, the power amplifier shall be completed with mixer. Power amplifier shall be capable of connecting with microphone, CD deck and cassette deck. Each power amplifier shall have built in On/Off switch, headphone outlet, volume control for each channel and matching transformers with tapping to enable loudspeakers to be driven at 100V, 70V or 50V up to 8Ω. An LED VU meter shall be provided to indicate the output level. The power output shall be adequate for the connected loudspeakers in the broadcasting zone.

For multiple broadcasting zones, each zone shall be provided with a power amplifier.

Power amplifier shall be provided with input transformers for audio inputs from the preamplifier and built-in loudspeaker matching transformer. It shall have built in On/Off switch, headphone outlet and an LED VU meter showing the output level. The power output shall be adequate for the number of connected loudspeakers within the zone.

(c) Loudspeaker

Loudspeaker shall provide a crisp, clear audio reproduction for voice and alarm tone signalling, designed for fast and easy surface/flush installation on ceiling or wall. It shall be constructed of sheet steel or high impact ABS plastic in white colour or as specified matching the false ceiling or wall finishes. The back of the loudspeaker shall have an enclosure to prevent ingress of dirt to the speaker zone. Loudspeaker installed on false ceiling shall be suitable for flush mounting with the body fully recessed into the false ceiling.

Loudspeaker installed in plant room or any other places without false ceiling shall complete with surface mounting boxes which include knock-out for surface conduit installation.

Loudspeaker shall be equipped with tapped transformer suitable for the system operating voltage and having individual attenuator. The attenuator shall be integrated with the speaker unit and shall comprise carbon type volume controls with adjustment.

Loudspeaker shall have a maximum output rating of at least 1 Watt and a frequency response of within +3 and -7 dB from 100 to 10,000 Hz with respect to 1 kHz.

The layout of the loudspeakers as shown on the Drawings is for the indication of the areas where the audio announcement is required to be provided. The Contractor shall design the audio system and co-ordinate with the Building Contractor and other sub-contractors for the exact quantity and positioning of the loudspeakers.

Where the loudspeakers specified are provided by others, the Contractor shall co-ordinate with relevant parties on the installation of the loudspeakers for completion of the audio system. The Contractor shall supply and install compatible equipment for operating the loudspeakers without affecting other systems connected to the loudspeakers.

(d) Cassette Deck

Cassette deck shall have two individual cassette players with standard interlocking set of play, stop, pause, fast forward and fast reverse buttons and auto-reverse playback feature. It shall have a playing tape speed of 4.75 cm/s and a nominal output signal of 1 V. Signal to noise ratio shall be better than 40 dB. It shall complete with a remote start-stop control from the monitor and control panel.

Two high quality cassette tapes of 60 minutes shall be supplied. The tapes shall be fully recorded on both sides with the specified audio alarm messages repeatedly. A sample of the tape with the recorded messages shall be submitted to the Architect for approval.

Alternatively, the Contractor may use approved system with message recorded on an electronic chip. The Contractor shall propose details of the system using electronic chip to the Architect for approval.

(e) Control and Monitoring

The Contractor shall supply and install a wall mounted panel for the control and monitoring of the audio system as specified.

The monitoring and control system shall be backed up by battery and charger in Clause B8.10. Except for the proprietary control panel of FSD approved type and manufactured with ISO 9001:2000 quality assurance system, the housing of panel and front panel shall be constructed from 1.6 mm thick stainless steel sheet to BS EN 10088-1: 2005 No. 1.4401 with engraved labels and lettering.

(f) Audio Alarm Messages

Audio alarm message in Cantonese and English shall be announced repeatedly with the audio alarm bell signal in sequence. The message shall be as required by the FSD and will be similar to the following: -

"This is a fire alarm message. Please keep calm. Follow the flashing lights to the nearest exit. Do not use the lift", and in equivalent Cantonese as:

"這是一個火警警報, 請保持冷靜, 依閃燈指示, 由就近出路牌方向離開, 切勿使用升降機。 "

The message shall be audible in all areas within the specified zone of the building including toilets, stores, staircases etc. The signal to noise ratio shall not be less than 40 dB when the loudspeaker output level in the area concerned is not less than 20 dB above the background noise level normally expected in the respective area during fire conditions. The variation in sound power level between the outlet nearest to and farthest from the amplifier shall not exceed 3 dB.

B7.3 VISUAL SYSTEM

Visual system shall consist of a system of coloured and flashing lights that may be incorporated into the illuminated exit signs and related directional signs, and may be supplemented by additional signs, low level lights, and low-level directional signs to assist building occupants and public visitors to escape quickly during fire. The system shall be approved by the Architect and shall comply with FSDCoP, FSD Requirements and Circular Letters, BS 5499-1: 2002, BS 5499-4: 2000, BS EN 60598-1: 2004, BS EN 60598-2-22: 1999, BS 5266-1: 2005, BS EN 50172: 2004 and BS EN 1838: 1999 unless otherwise specified. Design and construction details of visual system shall be submitted for approval.

(a) The design of illuminated exit signs and related directional signs shall conform to Clause B11.2. A flashing light control gear shall be integrated with each sign as required. An independent circuit including a separate set of lamp-holder, wiring and protective gear shall be provided for each lamp element. In normal situation, the lamp elements shall be in the ON condition and they can be changed to flashing mode in emergency. Where separate set of flashing lights or signs is proposed, they shall be submitted to the Architect for approval.

(b) Low-level lights where required shall be internally illuminated and comply with relevant requirements in Clause B11.2. Flashing light control gear shall be provided as required. During fire condition, the flashing shall be operated in a way to indicate the direction of exit on a floor or floors requiring evacuation.

(c) The evacuation routes may be supplemented by low-level directional signs of non-flashing photo-luminous type, or other signs to the approval of the Architect.

Construction of signs in visual system, the luminance output, and the words, colour and size of signs used in the system shall comply with Clause B11.2 and to the approval of the Architect. The signs and associated flashing lights shall be of design easily visible, conspicuous and legible in fire and smoke conditions.

The sign in visual system shall be safe in construction and use. It shall not create any harmful effect and not generate any additional risk and liability to the building occupants, workers and public visitors during the whole period of use.

The construction details, finishes, appearance and performance data of the signs shall be submitted to the Architect for approval before fabrication. The Contractor shall allow modifying the appearance and details of the signs to the satisfaction of the Architect.

The average luminance of visual system shall not decrease by more than 30% of its initial design value throughout its rated life in continuous operation when operated at ambient temperature between 5^{o}C and 40^{o}C.

The battery, battery charger, wiring, testing facilities, automatic changeover switch, accessories and related provisions of illuminated signs shall comply with relevant requirements of emergency lighting installation and the requirements specified in Clause B8.10, Clause B11.1, Clause B11.2, BS 5266-1: 2005, BS EN 50172: 2004 and BS EN 1838: 1999. The battery shall be of capacity adequate to maintain light output of all lamps as well as the flashing lights for a period of not less than the period specified for emergency lighting installation during emergency in Clause B11.1 and in any case shall be not less than 2 hours after mains failure.

B7.4 OPERATION OF THE SYSTEM

The audio/visual advisory system shall interconnect with the fire alarm system of the building. When the fire alarm is activated, the following operations shall be performed automatically: -

(a) The flashing light control gear of all the illuminated directional signs and exit signs which are incorporated with flashing lights within the fire alarm zone shall operate. The lamp elements shall be switched on and off continuously at a duration of 1 to 2 seconds. The flashing rate shall be continuously adjustable between 30 to 60 times per minute. All the lamp elements in the directional sign shall be lighted up and turned off simultaneously to produce the maximum visual effect. The process shall continue until the fire alarm is reset. Then the lamp elements shall be switched back to the normal ON condition automatically and shall be switched to the flashing mode again on receiving any further fire alarm signal.

(b) The alarm bells and flashing light units within the alarm zone shall operate. After 10 seconds, the alarm bells shall stop while the flashing light units shall continue to flash. Then the pre-recorded audio alarm messages shall announce within the alarm zone to alert the occupants and direct them to evacuate immediately following the directional and exit signs. The alarm bells and the audio alarm messages shall repeat in sequence continuously until the fire alarm has been reset at the fire alarm panel.

B7.5 CONTROL SYSTEM

The complete audio/visual system shall be equipped with all the necessary circuits and components for the proper control and operation of various functions, the indications of the health status of the system, and any fault diagnosis. The circuits and components shall be in printed circuit modular board design. The components shall include the following items and any other items necessary for the proper control and operation of the system to the satisfaction of the FSD: -

(a) microphone control panel;

(b) speaker zone switch bank and annunciator module;

(c) tape transfer, power supervisor and remote transmission module;

(d) automatic timer sequencer which shall be a multi-function assembly to provide pre-recorded messages, timing sequences, transfer function plus supervisory signal to amplifiers;

(e) alarm failure transfer units which shall transfer audio output from main duty amplifiers to standby amplifiers upon detecting the absence of a supervisory signal;

(f) general alarm and all call module;

(g) alarm input transfer module for controlling the amplifiers.

The microphone control panel shall contain dual pre-amplifiers continuously supervised. It shall have the ability to transfer to the standby pre-amplifier upon failure of the duty unit. A noise cancelling hand microphone having a UL listed and supervised coil cord shall be provided. Provision for automatic alarm zone override of speaker switching shall also be included to ensure proper alarm zoning if the selector switches are left in an incorrect mode.

The speaker zone selector switch bank shall control the audio dispersion throughout the protected premises. Each switch shall permit the transfer of its zone of speakers into either all call, page and fire operation modes. Failure of any zone shall be indicated by the corresponding amber LED. Indicators for alarm and switch bank trouble shall also be supplied and installed.

Tape transfer, power supervisor and remote transmission module shall supervise the remote rack equipment, provide output and supervision of the remote transmitting function, and control the sequencing of evacuation tape messages and the selection of tape track.

The system shall not cause any interference with all electrical or electronic system, the telephone system, radio paging system, audible paging and other communication system and vice versa, whether they are in operation or not.

The operation of all controls shall be automatic and as simple as possible. The operating procedures shall be provided to give concise and clear indications. Where it is considered necessary, these indications shall be accompanied by the connection diagram which shall show the various operation alternatives available to each equipment.

All equipment shall be mounted in well ventilated but water protected stainless steel enclosure and equipment rack. Where permanently fixed in position, the top and undersides of the equipment shall be readily accessible by means of removable panels. The metal enclosures shall be secured and have sufficient space for cable routing and bending. Except for the proprietary equipment enclosure that have been accepted by the FSD and manufactured with ISO 9001:2000 quality assurance system, the housing shall be constructed from BS EN 10088-1: 2005 No. 1.4401 stainless steel of 1.6 mm thick minimum, well ventilated but shall be free from any dust and be vermin and corrosion proof. All operating controls and equipment shall be adequately labelled to assist ease of operation and maintenance of the system.

B7.6 WIRING INSTALLATIONS

The wiring installation for the audio/visual advisory system shall be supplied and installed by the Contractor except the power supply to the exit signs, the directional signs, the amplifiers and the monitoring and control panel as indicated on the Drawings.

The wiring to the loudspeakers and the directional signs shall be installed in concealed conduits, and the wiring shall be so arranged that any damage to the wiring for any one loudspeaker or directional sign shall not affect the proper operation of all other loudspeakers nor directional signs. All cables shall run continuously from the originating point to termination and no joint or connector shall be permitted. The amplifier output circuits to the loudspeakers shall use twin cables with low power loss and protected against interference. Care shall be taken to ensure that each loudspeaker is correctly phased.

SECTION B8

FIRE ALARM CONTROL SYSTEM

B8.1 GENERAL

The Contractor shall supply and install fire alarm control system and all necessary controls for the whole fire service installation including equipment for fire control centre. The Contractor shall be responsible for the design of fire alarm control system. There shall be at least one fire alarm control and indicating panel in the system with additional repeater panels installed at appropriate locations and as required.

Fire alarm control and indicating panel shall comply with BS EN 54-2: 1998. The fire alarm control and indicating panel shall be constructed of, or enclosed with cabinet, at least 1.6 mm stainless steel plate to BS EN 10088-1: 2005 No. 1.4401, except for the proprietary control panel that has been accepted by the FSD and manufactured with ISO 9001:2000 quality assurance system or equivalent. A glazed lockable door shall be supplied and installed to restrict access to the control switches but allowing a full view of the visual indications. The panel shall afford a degree of protection to at least IP 52 under BS EN 60529: 1992. The fire alarm control system shall be conventional hard wire type or a type approved by the FSD, and approved by the Architect.

The system shall have devices to detect and raise fire alarm for open or short circuited condition of the system. Where a residual current device is required in order to comply with the statutory requirements for electrical installation, a fault on any circuit or equipment shall not result in isolation of the supply to the fire alarm control system. The system loop design shall be such that the actuation of any detection device or when there is any fault in the loop shall not cause the loop to be disabled for the alarm and trouble signals to be followed.

The Contractor shall submit the layout, design and construction of all the fire alarm control and indication panels and repeater panels for approval.

All wirings in the panels shall be neatly arranged and grouped together. Proper labels shall be supplied and installed.

The Contractor shall supply and install surge arresters for the fire alarm control system to prevent false fire alarms and malfunctioning of the fire alarm control system due to power and lightning surge.

Where time related system, transmission delay unit and/or similar features are needed, the Contractor shall submit to the FSD for approval in accordance with FSD Circular Letter No. 4/2001. The time delay shall be adjustable from 0 to 5 minutes or such longer period as agreed by the FSD and approved by the Architect. The final setting of the time delay shall be agreed with the FSD.

Time related system shall be provided to automatic fire alarm system unless otherwise specified.

Where automatic fire alarm system is provided., fire alarm control system and associated fire alarm control and indicating panels shall be analogue addressable type

To cater for maintenance and future alteration of fire alarm control system, the Contractor shall supply and install approved addressable system from manufacturer who can provide relevant programming information, manuals, details, keys, hardware locks, training and passwords. The Contractor shall not select and install addressable system from manufacturer who cannot provide/release the programming information, hardware locks and password information to the Architect, future users and maintenance bodies. The programming information will be limited to those that are required for routine maintenance, diagnosis and repair works, and for future upgrading and modification works such as relocation, change, deletion, addition etc. The Contractor shall confirm with the manufacturer on this requirement before placing order.

The Contractor shall check and ensure the compatibility of all the components/devices in the system manufactured by different firms. The Contractor shall obtain confirmation or certificate on the compatibility from each source or manufacturer to guarantee that the various items are totally compatible for approval by the Architect. In this respect, a certificate from one source will not be accepted. Fire alarm control system with all the components/devices supplied by one manufacturer shall be used when confirmation is not available.

The Contractor shall be responsible to pay all the charge for the connection and service for linking with the FSD's approved centre and the associated communication line (e.g. telephone point, dedicated telephone line etc.) installation/connection/hiring fee for the whole Maintenance Period.

B8.2 CONVENTIONAL FIRE ALARM CONTROL AND INDICATING PANEL

Conventional fire alarm control and indicating panel shall be supplied and installed to monitor centrally the manual fire alarm system, fire hydrant and hose reel installation, VAC control system and other fire service installations and equipment. The panel shall be equipped to suit the manual fire alarm system. Fire alarm signals may originate from manual call points, flow switches, pressure switches, gaseous flooding system alarm contacts etc. as applicable. The connection of these devices in zone (alarm circuits) shall be as specified.

The panel shall include the following minimum provisions: -

Service Features

(a) Relays, terminal strips, wiring, labels etc. for the proper operation of the whole system including alarm bells;

(b) Auxiliary relay or additional relay contacts for automatic starting of water pumps and other devices as specified;

(c) Test facilities for each alarm zone.

User Control Switches

(a) System isolation key switch;

(b) Zone isolating key switch;

(c) Alarm silencing switch with warning buzzer and indication;

(d) Buzzer mute;

(e) Sound alarm switch for all indicator circuits and internal buzzer;

(f) System reset switch after clearance of an alarm or fault condition;

(g) Lamp test switch;

(h) Pump start switch;

(i) Key switches for isolating signals to the VAC control system, to the fire shutters and to the lift controls with visual warning indication;

(j) Other necessary controls for fire hydrant/hose reel system and sprinkler system as required by the FSD.

Visual Indicators

(a) "Supply On" visual indicator, green;

(b) "System On" visual indicator, green;

(c) "System or Device Isolated" visual indicator, amber with buzzer;

(d) "Fire" alarm visual indicator for each zone, red;

(e) "Zone Fault" visual indicator, amber;

(f) "System Fault" visual indicator, amber;

(g) "Battery" condition (full/charging/low) visual indicator, green/amber/red respectively;

(h) "Battery Charger Fault" visual indicator, red;

(i) "Zone Disable" visual indicator, amber;

(j) "Tank Low Level" and "Tank High Level" visual indicators, amber;

(k) "Pump Running" visual indicator, green;

(l) "Pump fault" visual indicator, red;

(m) "Essential Power On" *or* emergency generator running visual indication, amber;

(n) Subsidiary sprinkler stop valves status visual indication, red (light up when valve closed);

(o) Sprinkler control valve set status monitoring, amber;

(p) Sprinkler flow switches activation visual indication, red;

(q) Fire alarm direct link fault/isolation indication, red;

(r) Emergency generator manual mode visual indicator, amber;

(s) Emergency generator fail to start visual indicator, red;

(t) Emergency generator fuel tank low level visual indicator, red;

(u) Other necessary indications for fire hydrant/hose reel system, sprinkler system etc. as required by the FSD.

All visual indications shall be provided with twin indication LED lamps of approved size, brightness and colour. All visual indications and labelling shall be easily seen at 2 m away from the panel.

Upon operation of one or more triggering devices, the control panel shall generate a fire alarm indication by: -

(a) At least one internal alarm sounder in or near the indicating equipment;

(b) At least one external alarm sounder;

(c) A visible indication for each zone in which a triggering device operates;

(d) Where specified, a signal transmitted to the FSD through the fire alarm direct link and the Computerized Fire Alarm Transmission System.

Fire alarm control system shall be arranged for continuous monitoring of all alarm circuits, including the wiring and the alarm signalling devices connected thereto.

Faults to be detected shall include open-circuits, short-circuits, and removal of signalling devices.

Indicator lamps shall be of a voltage rating 20% higher than the applied voltage, and shall be of extra low voltage type. Where A.C. mains operation is required, indicator lamps shall be operated at extra low voltage via a step-down transformer and be suitably rated for long life and reliability.

Alarm bell circuits shall be interleaved and separately fused at the control equipment.

Relays shall be of the potted type or similarly protected against dust and shall have solenoids with varnish-impregnated or plastic encapsulated windings.

Contacts shall be of silver and adequately rated. Additional contacts shall be supplied and installed as required for the operation of auxiliary controls.

The control equipment shall incorporate battery charger set with appropriate voltage regulators suitable for the rating of the interconnected triggering devices and the equipment shall incorporate overload cut-out or limiting devices to protect the external circuit against excessive current.

B8.3 AUTOMATIC FIRE ALARM CONTROL AND INDICATING PANEL

In addition to the conventional fire alarm control and indicating panel, automatic fire alarm control and indicating panel shall be provided for system containing automatic fire alarm system. All control functions of the conventional fire alarm control and indicating panel may also be incorporated and integrated with the automatic fire alarm control and indicating panel as one panel when provided.

The automatic fire alarm control and indicating panel shall be of FSD approved type and approved by the Architect and shall be microprocessor based. The panel shall be of a type approved by LPCB or similar widely recognised independent regulatory body. Fire alarm signals may originate from heat detector, smoke detector, multi-sensors detector and/or other automatic fire detection devices as applicable.

At least one automatic fire alarm control and indicating panel shall be supplied and installed to monitor centrally the automatic fire alarm system and the like. For addressable fire alarm system, addressable fire alarm control and indicating panel shall be supplied and installed as the automatic fire alarm control and indicating panel.

The panel shall be able to transmit fire alarm signals to the FSD Computerized Fire Alarm Transmission System without any external connection module.

The panel shall allow detectors in any individual zone and sounders to be tested during commissioning or maintenance by a single person, i.e. one-man test facility.

The panel shall contain the following minimum provisions: -

Service Features

(a) At least two alarm circuits;

(b) At least two pairs of auxiliary contacts;

(c) Comprehensive fault monitoring devices;

(d) One-man test facility;

(e) Integral power supply;

(f) Back up sealed nickel-metal hydride battery (or for battery power capacity exceeding 50Ah, battery of equivalent or better functions and environmental performance approved by the Architect).

User Control Switches

(a) Zone isolation switch with visual indication;

(b) Alarm silence switch with visual indication;

(c) System reset;

(d) Lamp test.

Visual Indicators

(a) Mains on, green;

(b) System isolated, amber;

(c) System fault, amber;

(d) Zone fire alarm visual indicator using twin LED, red;

(e) Zone fault/isolated LEDs indications, amber;

(f) Status of equipment controlled by detectors e.g. ‘closed’ status of fire shutter, amber.

The control equipment shall incorporate battery charger set with appropriate voltage regulators.

B8.4 AUTOMATIC SPRINKLER SYSTEM ALARM CONTROL AND INDICATING PANEL

The panel for automatic sprinkler system shall comply with the LPC Rules for Sprinkler Installations. At least one automatic sprinkler system alarm control and indicating panel shall be supplied and installed for the sprinkler installation. It can be combined and integrated with the automatic fire alarm control and indicating panel or conventional fire alarm control and indicating panel where allowed and accepted by the FSD.

B8.5 ADDRESSABLE FIRE ALARM CONTROL AND INDICATING PANEL

Where addressable fire alarm system is provided, addressable fire alarm control and indication panel shall be supplied and installed. The addressable fire alarm control and indicating panel shall be analogue addressable intelligent type with its own microprocessor and memory. The panel shall be FSD approved type and approved by the Architect and shall be microprocessor based. The panel shall be of a type approved by LPCB or similar widely recognised independent regulatory body. All detectors, sensing devices and control devices connected to the addressable panel and automatic fire alarm system shall be of compatible addressable types acceptable to the Architect.

In addition to the intelligent functions, LED indicating lights and LCD panel together with audible alarm shall be included in the panel to provide alarm/detection zoning requirements as specified and in accordance with the FSDCoP, FSD Requirements and Circular Letters as well as the following monitoring signals, where applicable: -

(a) Status of micro-switch for each sprinkler subsidiary stop valve;

(b) 'Closed' status of each fire resistant shutters operated by smoke detector;

(c) Running of each sprinkler pump;

(d) Running of sprinkler jockey pump;

(e) Fault/loss of power supply to sprinkler/jockey pumps;

(f) Sprinkler tank overflow alarm;

(g) Sprinkler tank low level alarm;

(h) Running of each fixed fire pump;

(i) Fault/loss of power supply to fixed fire pumps;

(j) Fire service tank overflow alarm;

(k) Fire service tank low level alarm;

(l) Running of each intermediate booster pump;

(m) Fault/loss of power supply to intermediate booster pumps;

(n) Running of each transfer pump;

(o) Fault/loss of power supply to transfer pumps;

(p) Transfer tank overflow alarm;

(q) Transfer tank low level alarm;

(r) Running of each foam system water pump;

(s) Fault/loss of power supply to foam system water pumps;

(t) Foam system water tank overflow alarm;

(u) Foam system water tank low level alarm;

(Add running and alarm indications for other pumps and tanks as necessary)

(v) System fault;

(w) Circuit fault;

(x) Status of power supply including normal supply, essential power on, emergency generator manual mode, emergency generator fail to start and fuel tank low level;

(y) Line normal and line fault/isolation of fire alarm direct link;

(z) 4 nos. spare allowed on each panel for additional alarm points.

Also, the following control functions in the form of push button or key switch integrated as part of the panel shall be supplied and installed, where applicable: -

(a) Manual starting of each fixed fire pump;

(b) Manual starting of each intermediate booster pump;

(c) Manual starting of each sprinkler pump;

(d) Manual starting of each transfer pump;

(e) Manual starting of each foam system water pump;

(Add controls for other pumps as necessary)

(f) Alarm test and lamp test facilities;

(g) Key switch for system isolation with visual indicator;

(h) Key switch for stopping transmission of fire signal to ventilation control system and lift installation with visual indicators;

(i) Alarm and buzzer mute;

(j) All the control and indicating functions of conventional fire alarm control and indicating panel and automatic fire alarm control and indicating panel in Sections B8.2 and B8.3 as appropriate.

The panel shall drive four wire loops of addressable analogue fire/smoke sensing, signalling, monitoring and communication devices or better design and approved. The panel shall have output ports for the connection of external printer and monitor, and allow for expansion of the system. The loop shall be self powered for all sensing, signalling, monitoring and communication functions. Upon a communication failure anywhere on the loop or power failure, a failure alarm shall be reported. Each loop shall have a minimum of 30% spare for intelligent sensors/detectors and 20% for addressable modules. The addressable panel shall have a minimum of 10% spare to cater for future expansion and modification.

The panel shall process all analogue values for normal, trouble, pre-alarm and alarm thresholds. Thresholds and sensor values shall be displayable, modifiable and reportable in decimal values.

The panel shall be able to connect to intelligent addressable sensors and conventional alarm initiating circuits as specified. Independent modules for alarm zones (e.g. break glass zone, detector zone, sprinkler flow switch zone) and trouble zones (e.g. subsidiary valve shut off) shall be provided on a floor-by-floor or zone-by-zone basis.

The panel shall include backup batteries and battery charger and provide all power necessary for the devices connected to it and built-in the panel.

Except for approved proprietary panel manufactured with ISO 9001:2000 quality assurance system, the panel shall be made of minimum 1.6 mm thick stainless steel to BS EN 10088-1: 2005 No. 1.4401 or other approved material by the Architect. Access to the panel switches and all panel electronics shall be via key locks; no other tools shall be required. Visual indicators for the panel status shall be visible. Push buttons for pumps shall be accessible without opening the key locked cover.

All hardware and software which define the panel configuration and operation shall be supplied and installed. Memory data shall be contained in non-volatile memory. Memory data shall not be lost after long power failure.

The pre-alarm and alarm thresholds of detectors connected to the system shall be adjustable through the panel. In addition, the panel shall be able to provide time related features and transmission delay unit for alarm verification with field adjustable time from 0 to 5 minutes.

The system shall have drift compensation provision to distinguish long term change due to dirt accumulation from the short term variation due to fire, have fire detection algorithms and signal integration capability so as to avoid false fire alarms caused by transient interference and adjustable sensitivity setting to cater for different environment. The system shall have self diagnostic function to detect every deviation from the normal operating condition or automatically emit service signal if a detector is contaminated (automatic detector maintenance alert function). The system shall have features to allow output of alarm be delayed for immediate on-site investigation, to allow individual detector zone, individual sensor in multi-sensors detector, individual detector etc be individually disabled, and to have user programmable output while programme edit does not interfere normal operation. The system shall also have all the features for addressable system as specified in Clause B6.15.

Location, type, address and condition of each device in the system shall be displayed through a built-in LCD panel automatically in case of alarm or trouble. The display on the LCD panel shall be in a user friendly format. It shall also be time stamped.

All other changes of status shall also be displayed in the LCD panel giving at least the following information

(a) Condition of point;

(b) Type of point (smoke/heat detector/sprinkler flow switch/break glass unit etc.);

(c) Location of point plus numerical system address;

(d) All other points appearing on the panel.

Individual red alarm and common yellow trouble LEDs shall be supplied and installed for each initiating and for each indicating zone. Devices on intelligent loop circuits shall be identified by display of their addresses, locations and types, and by their conditions (Alarm, Pre-alarm, Fault) on the built-in LCD panel. In addition, the conditions shall be displayed on the appropriate intelligent loop interface board.

Individual zone disconnect switches/facilities shall be supplied and installed, which shall prevent operation of the zone for alarm but allow the remainder of the panel to operate normally. While the disconnect switch is activated, a trouble condition shall be indicated on the zone as well as an indication of "Disconnect". Devices on intelligent loop circuits shall be capable of being disabled by authorized personnel from the panel.

It shall be possible to command test, reset, and alarm silence from the panel.

If communications with the central processing unit board inside the panel is interrupted for any reasons, the following critical control actions shall still occur at the panel. Upon determination of an alarm condition, the panel shall : -

(a) Activate the fire alarm signalling devices;

(b) Release fire shutters as specified;

(c) Capture the lifts and return them to the home landing as specified;

(d) Raise alarms in accordance with FSD Requirements and Circular Letters;

(e) Initiate the alarm transmitter to the Fire Services Department Computerized Fire Alarm Transmission System via telephone line;

(f) Activate various fire service water pumps and other fire fighting systems as specified;

(g) Stop ventilation system as specified;

(h) Display the sensor or module address and condition.

The panel switches/facilities shall allow authorized personnel to accomplish the following : -

(a) Initiate a general alarm condition;

(b) Silence the local buzzer;

(c) Silence the alarm signals;

(d) Activate and reset the alarm transmitter to the Fire Services Department Computerized Fire Alarm Transmission System via telephone line;

(e) Reset all zones after all initiating devices have been returned to normal;

(f) Perform a complete system test with a visual indication of numbers of all detectors in normal working condition;

(g) Test all panel LEDs for proper operation without causing a change in the condition on any zone;

(h) Eliminate a device mismatch condition by changing the device type. The panel shall always operate with thresholds unique to the device type, and shall do so whether or not the mismatch has been eliminated.

An event printer shall be supplied, installed and connected to the panel. The event printer shall be integrated into and form part of the panel, unless a separate wall mounted event printer is accepted by the Architect. It shall be activated either by a fire alarm condition or by commands entered through the panel for the printing of system data essential for preventive maintenance. The print out for each alarm or trouble signal shall at least provide the following information:-

(a) Condition of point;

(b) Type of point;

(c) Location of point plus numerical system address.

The printer shall be capable of printing a minimum of twenty four characters per line and the minimum operating speed shall be 2 lines per second.

Operation of the printer shall not inhibit, delay or affect the functioning of the alarm and control system in anyway.

Where a separate event printer is provided and accepted by the Architect, the Contractor shall supply and install a wall mounted stand/rack near the panel to the approval of the Architect for housing the printer. Details of the stand shall be submitted for approval.

B8.6 ALARM REPEATER PANEL

Alarm repeater panels having indicators for each zone of the fire alarm system shall be supplied and installed at locations as specified. They shall be provided with their own backup battery and charger set. The panel layout and configuration shall be submitted for approval.

Mimic diagrams, where specified, shall be of engraved laminated plastic or other approved non-deteriorating materials as specified and all lettering shall be legible in both English and Chinese.

B8.7 COMPONENTS AND EQUIPMENT COMPATIBILITY

All the devices, components and equipment used in the system shall be of the highest quality and suitable for humid tropical working conditions. They shall be fully compatible with one another within the whole system. The whole system shall comply with BS EN 54-13.

Special attention is drawn to the compatibility between automatic detectors and control and indicating equipment and the Contractor shall supply information on the detectors and their required electrical interface with the control and indicating equipment. All the components in such a system shall preferably be from one principal system manufacturer forming one compatible system approved by LPCB or similar widely recognised independent regulatory body.

B8.8 ALARM TRANSMITTER

The alarm transmitter shall be compatible with the Fire Services Department Computerized Fire Alarm Transmission System.

The Contractor shall initiate applications to the appropriate agencies within 3 months after commencement of the Contract to allow the fire alarm direct link to be completed, connected and tested at least one month before statutory inspections by the FSD. The Contractor shall submit a copy of the application document to the Architect for record. The Contractor shall co-ordinate and shall closely monitor the completion status of the fire alarm direct link and associated telephone line before the fire service inspection by the FSD.

The Contractor shall apply for and provide at the Contractor's own cost the required telephone point for connection of the fire alarm direct link. The Contractor shall co-ordinate with relevant parties and shall arrange the power supply point for the fire alarm control and indicating panel and fire alarm direct link as necessary. The Contractor shall be responsible to pay the initial, rental and maintenance charges for the leased line for fire alarm direct link and associated telephone point from completion to the end of the Maintenance Period. The Contractor shall supply and install all conduit works for the fire alarm direct link and associated telephone point.

If the Contractor cannot complete the fire alarm direct link by the date of fire service inspection by the FSD, the Contractor shall be responsible for providing all necessary manpower and telephone equipment, at the Contractor's own expenses, solely for the purpose for a 24-hour/day full attendant service to substitute the fire alarm direct link up to the date of the completion of the fire alarm direct link.

Key switch control shall be provided for the temporary isolation or suspension of fire alarm direct link with visual warning indication during routine testing of fire service installation.

B8.9 CONTROL FOR AUXILIARY SYSTEMS

Control for the operation of auxiliary systems, including intermediate booster pump, audio/visual advisory system, fire damper release mechanism, door release mechanism, smoke extract fan, ventilation system, public address system, fireman's lift control etc., where specified, shall comply with the requirements of the FSD and the Contractor shall carry out all associated electrical control wiring and connections unless otherwise specified. Relevant visual and audible alarm indications shall be provided on the fire alarm control and indicating panel.

B8.10 BATTERY AND CHARGER

All equipment in the fire alarm control system shall be backed up by storage battery and battery charger set. The storage battery and battery charger set shall be a solid-state secondary D.C. power supply unit operating in parallel with a storage battery bank. The exact rated capacity shall be designed by the Contractor to supply a constant voltage and current for the combined standing load and alarm load.

The storage battery and battery charger set shall be capable of maintaining the system in normal operation for a period at least 24 hours without recharging and thereafter shall remain capable of operating in the maximum "alarm" condition for at least 30 minutes for all connected units and/or capable of actuating the fire service installation as required.

If the system is connected by an alternative standby supply such as an automatically started emergency generator designed for 6 hours standby capacity, the capacity of the storage battery and charger unit may be proportionally reduced, that is, the system shall be capable of maintaining the system in normal operation for 18 hours and thereafter capable of operating in the maximum "alarm" condition for at least 30 minutes and capable of actuating the fire service installation as required.

The charger unit shall be able to recharge and restoring the battery bank back to its constant potential voltage setting in not more than 12 hours after fully discharged.

The Contractor shall submit calculation to demonstrate that the capacity of the battery and charger unit is able to cope with the power demand of the whole system. In any case, the ampere-hour rating of the battery shall not be less than 10 AH.

The battery shall be of sufficient voltage to transmit signals to the Fire Services Department Computerized Fire Alarm Transmission System via the alarm transmitter unit and the telephone lines.

The charger unit shall consist of a rectifier bridge which has the A.C. mains input supplied via an isolation transformer and has the ripples of its D.C. output smoothed by a D.C. filter before supplying the connected load under normal operation or the battery after discharging in A.C. mains failure. The charging process shall be automatically controlled and switched by a control logic unit made up of printed circuit boards.

The battery charger set shall be manufactured to conform to the current editions of the relevant standards as indicated below -

BS EN 61204-6: 2001	Low voltage power supplies, d.c. output. Requirements for low-voltage power supplies of assessed performance
BS 5654-2: 1979 (IEC 60478-2)	Stabilized power supplies, d.c. output. Method of specifying rating and performance
BS 7430: 1998	Code of Practice for Earthing

The battery shall be sealed, maintenance free nickel-metal hydride type, and for battery power capacity exceeding 50Ah, battery of equivalent or better functions and environmental performance approved by the Architect. The battery shall have a proven life expectancy of at least 4 years. It shall not have any memory effect as to affect its usable life or performance. The nickel-metal hydride battery shall comply with BS EN 61951-2: 2003 where applicable. The battery charger unit shall be compatible with the batteries used.

The battery and charger set shall be designed and manufactured by a reputable manufacturer which has continuously manufactured battery and charger set to work in conjunction with a wide range of applications for at least 5 years and their manufacturing facility shall have a local agent to provide full technical support which includes adequate spare holding and technical expertise in testing, commissioning and trouble-shooting.

The following technical requirements shall apply: -

Input Voltage:	plus or minus 6% via 13A fused supply
Frequency:	50 Hz , plus or minus 2%.
Output Ripple Voltage:	$\pm$5% of D.C. output
Output Voltage:	To suit the offered fire alarm panel.
Output Current:	To suit the fire alarm system
Overcurrent Protection:	Mains fuse, charger fuse, battery fuse against overload and short circuit conditions.
Control:	Fully automatic
Instrument:	D.C. output voltmeter, D.C. output ammeter
Indication:	Mains and charger healthy Battery low-volt

Except for the approved proprietary unit manufactured with ISO 9001:2000 quality assurance system, the battery and charger set shall be housed in an industrial grade cabinet constructed from stainless steel to BS EN 10088-1: 2005 1 No. 1.4401 or other approved material of minimum 1.6 mm thick side and back plate and 1.6 mm thick hinged front door with key lock. Protection class of the cabinet shall not be less than IP 52 for indoors and IP 65 for outdoor application. If approved materials other than No. 1.4401 stainless steel is used, the entire enclosure surface shall be applied with chemical rust inhibitor, rust resisting primer coat and top coat to give maximum corrosion protection.

The logic printed circuit board, together with the isolation transformer and fused mains input terminals, shall be factory assembled on a plate located at the rear of the case. The power transistors shall be mounted on heat sinks, separated from the printed circuit board, on the back plate. The instruments and LED indicators shall be mounted on the front door of the cabinet. A lower ventilated compartment inside the cabinet provides adequate space for accommodation of the storage battery bank and ventilation.

The following technical information shall be submitted by the Contractor to the Architect for approval prior to the ordering of equipment: -

(a) Technical catalogues and specification, calculation sheet for charger and battery capacity;

(b) Power supply unit circuit diagram;

(c) Control circuit diagram;

(d) Power supply unit front plate layout; and

(e) Power supply unit console details.

The battery and charger set including the printed circuit board shall be factory assembled and tested prior to delivery on Site according to the manufacturer's testing manual. The delivery of battery and charger set to Site must be accompanied by the original factory test certificate. A statement or certificate shall be produced by the battery and charger set manufacturer for the proof of the life expectancy of the power supply unit.

B8.11 AUXILIARY BATTERY

Where battery operation of auxiliary control systems is required, a separate sealed nickel-metal hydride battery (or for battery power capacity exceeding 50Ah, battery of equivalent or better functions and environmental performance approved by the Architect) and charger set for these systems shall be supplied and installed and suitably labelled for indication. The main fire alarm system shall not be connected directly to any auxiliary circuits, other than those essential to the detection and alarm system as specified.

B8.12 TRAINING FOR ADDRESSABLE SYSTEM

The Contractor shall provide adequate and separate training courses to not less than eight persons nominated by the Architect to enable them to understand and familiarise with the use, maintenance, programming and re-programming of the addressable system. Details and the proposed training programme shall be submitted to the Architect for approval. The training shall be conducted during normal working hours by approved trainers of the manufacturer unless otherwise approved by the Architect. The training shall be so designed that after completion of the course, the trained persons shall be able to carry out all the functions as defined in their corresponding level of access.

B8.13 FIRE SERVICE COMPUTER SYSTEM

Fire service computer system shall be supplied and installed for large or complex fire service installation and where specified. Fire service computer system shall comprise a computer system for indication and monitoring of the operational status of fire service equipment and fire alarms. The computer system is used to facilitate the management and maintenance of fire service installation. The computer system shall not interfere with the operation of the fire alarm control system. When the computer system is down or has faults, the fire alarm control system shall still perform without any interruption.

Fire service computer system can be part of an integrated computer system for indication and monitoring of all building services systems in a building. Web-based computer software is preferred and shall be adopted unless otherwise approved by the Architect. Facilities shall also be built-in for easy monitoring and access of the fire service computer system from a remote site through the Internet when needed.

Where specified, web cameras shall be provided to key locations of fire service equipment including fire service pump room, fire control room or fire control centre, near the automatic detectors and hose reels etc. The web camera connected to the fire service computer system shall provide good quality high-resolution colour images for remote monitoring of the environment of the room and condition of fire service equipment, and for quick initial checking/confirmation of the fire alarm when received. Web cameras in public areas shall be concealed and complete with protective housing as approved.

Details and associated software of the fire service computer system shall be submitted to the Architect for approval.

SECTION B9

ELECTRICAL INSTALLATION

B9.1 GENERAL

The electrical installation shall include all switchgear, trunking, conduits and wiring works commencing from the electricity supply points provided by others as specified. The installation shall also include the interconnecting wiring works with other specified services, e.g. lift control, signage, fire damper/shutter, smoke control, ventilation/air-conditioning control system, central control and monitoring, direct telephone link etc.

B9.2 GENERAL ELECTRICAL SPECIFICATION

The electrical equipment, installation materials, cables, wiring, and installation practice, shall be to the standard called for in the relevant sections of the General Electrical Specification.

The Contractor shall employ Registered Electrical Workers of the appropriate grades in accordance with the Electricity Ordinance to carry out the electrical works for the fire service installation. All relevant certificates/test reports shall be duly signed by the Registered Electrical Contractor and the Registered Electrical Workers and submitted to the Architect for record.

All electrical equipment shall be rated for continuous duties at designed capacity. The circuits and equipment of the electrical installation shall be selected in such a manner that they are not susceptible to external electrical and magnetic interference as well as to supply harmonics on their normal operations and performance. On the other hand, they shall not cause interference, harmonics or other adverse effects to the normal and essential electrical supply systems as well as to other electrical equipment.

B9.3 ELECTRICITY SUPPLY

The electricity supply shall be 380 Volt 3 phase 50 Hz and 220 Volt single phase 50 Hz. All equipment and installations shall be suitable to operate with this main supply conditions. All equipment and installations shall be sized with continuous ratings at the designed duties with optimum performances and efficiencies, and with minimum acceptable temperature rises.

B9.4 WIRING SYSTEMS

Wiring shall be laid in concealed steel conduit and in steel trunking inside a fire rated protected enclosures/rooms/ducts unless otherwise specified. They shall be grouped and installed together in a neat and tidy manner.

B9.5 CONDUCTOR SIZES

Conductor sizes for alarm circuit wiring to automatic detectors and addressable fire alarm and control system shall be in accordance with the LPC Rules for AFA Installations and achieve satisfactory operation of the system. However, the conductor size shall not be less than 1.0 mm^2 in any case. The wiring system shall also be capable of being installed, and subsequently maintained, easily and without damage.

Conductor sizes for other application shall be strictly as required by the General Electrical Specification.

B9.6 CONDUIT AND TRUNKING SYSTEMS

Conduit and trunking shall be of steel complying with the General Electrical Specification. PVC conduit and trunking shall not be permitted.

In general, conduits shall be concealed, except in protected rooms having approved FRP rating such as in fire control room, pump room and sprinkler control valve cabinet/room, or unless otherwise specified. Conduit and trunking shall be completely separated from those of other services, and used exclusively and solely for the purpose with no wiring of other services present. Trunking shall only be used in fire rated protected enclosures/ducts/rooms having approved FRP rating.

Flexible conduits shall be used for the final connection from rigid conduits/boxes or trunkings to equipment. Each flexible conduit shall not be longer than 2 m in length. Suitable adaptors shall be installed at both ends of the flexible conduit. The adaptor shall be constructed from brass. Each adaptor shall comprise two parts, an inner core which screws into the bore of the conduit together with a ferrule which caps off the end of the conduit, so that the adaptor can provide an extremely strong joint. The core shall lock against the outer ferrule and also isolate any sharp cut edges in the conduit which can damage cables on insertion or in use.

Conduit and trunking shall be routed and installed in such a way as to give maximum protection against mechanical damage. Where it is unavoidable to run conduits across other services conduits, water pipes, air conditioning ducts etc., they shall be installed first and fixed closest to the structure.

Galvanised iron draw-wires of adequate size shall be provided in all empty conduits.

B9.7 EARTHING

Proper earthing shall be supplied and installed for the electrical and electronic equipment as well as bonding of all exposed conductive parts of the fire service installation to the main earthing system as specified in the General Electrical Specification. All conductive moving parts such as hinged door of panel, battery and charger cabinet etc. shall be properly and sufficiently bonded by suitably sized flexible insulated cables to the fixed conductive part of the panel.

B9.8 IDENTIFICATION OF CONDUCTORS, CABLES AND CABLE DUCTS

Identification of conductors and cables on LV power circuits shall be in accordance with New Cable Colour Code for Fixed Electrical Installations : Installation Guidelines published by the Electrical and Mechanical Services Department and as specified in the General Electrical Specification. ELV alarm circuit wiring identification shall follow BS 7671: 2001 and with red colour for the line conductors. Colour tracers may be used, in addition, to distinguish cables one from another.

All surface conduits, cable ducts and cable trays, exposed fire resistant cables, exposed low smoke zero halogen cables, exposed armoured cables, exposed MICC cables etc. forming part of the fire service installation supplied and installed by the Contractor, shall be colour coded in red in such a way as to permit ready identification. Banding by means of paint will be acceptable where this can be carried out permanently and effectively. Durable high quality red plastic self-adhesive tape may be used for armoured and MICC cables. Colour bands shall be applied at intervals not exceeding three metres.

Suitable identification plates shall be supplied and installed on all electrical equipment giving voltage, current, wattage or other ratings and manufacturer's name, trademarks or other descriptive markings by which the organization responsible for the product may be identified.

Each disconnecting means required for all electrical equipment and each electrical source of supply shall be legibly marked to indicate its purpose unless so located and arranged that the purpose is clearly self evident.

All markings and identifications shall be of sufficient durability to withstand the environmental effects.

B9.9 FIRE RESISTANT CABLES

Unless otherwise specified or approved by the Architect, fire resistant cables used for Fire Service Installation shall be of low smoke zero halogen type and shall comply with all the following standards :

(a) BS 6387: 1994 Category CWZ;

(b) BS EN 50200 (class PH30 or better);

(c) BS EN 61034-1: 2005 or IEC 61034-1 or 2: 2005;

(d) BS EN 50267-2: 1999 or IEC 60754-1: 1994 / IEC 60754-2: 1991: (with less than 0.5% acid gas emission and pH level for the gases evolved not less than 4.3); and

(e) BS 7629-1: 1997 or BS 7846: 2000 where applicable for relevant types of cables under the standard.

Or products having equivalent performance to all the above standards, and approved by LPCB, BASEC (British Approval Services for Electrical Cables) or similar widely recognised independent regulatory body and the Architect.

For applications in different parts of fire service installation, fire resistant cables shall also comply with other standards as appropriate including BS 5839, BS 8434, BS EN 60332-2-2, BS EN 50266-2-1 TO 2-5: 2001, BS 5266-1: 2005, BS EN 50172: 2004, etc.

Where mineral insulated copper cables are specified, the cables shall comply with BS EN 60702 -1:2002.

B9.10 MOTOR STARTER AND CONTROL AND INDICATING PANEL

Except for the proprietary motor starter accepted by the FSD and manufactured with ISO 9001:2000 quality system, the enclosure for the motor starter and its control and indicating panel shall be constructed from at least 1.6 mm thick steel plate with lockable door. The enclosure for the motor starter and its control and indicating panel shall have a degree of protection not less than IP 65 as specified in BS EN 60529: 1992. The enclosure shall be finished in white colour internally and grey colour externally. All electrical live parts shall be properly covered and protected from accidentally touched.

Control cables inside panel shall be neatly laid out and securely fastened. They shall be terminated in connection blocks where a schedule ferrule numbering system shall be provided. The numbering system shall be clearly indicated on the as-built schematic diagram attached to the back of the panel front door.

Where the motor starter forms a part of a motor control cubicle or cubicle switchboard, the requirements in this clause shall be applied to the cubicle sections where the motor starter and its control and indicating panel are installed.

B9.11 CABLES AND WIRING USED FOR FIRE SERVICE INSTALLATION

Unless otherwise specified, the Contractor shall use fire resistant cables complying with Clause B9.9 for all installations listed in Table 3 for different parts of fire service installation or cables having equivalent or better performance to the approval of the Architect. Where wiring in concealed conduit is one of the acceptable methods for the installations outside plant room, it shall be used as the preferred installation method. Armoured cable shall only be used outside plant room where the use of concealed conduit is not acceptable.

Table 3 indicates the minimum requirements only. Where special cable standards and requirements are specified for any part of the fire service installation and/or required by the FSD, the most stringent standards and requirements shall be followed.

Table 3 : Installations to use Fire Resistant Cables

Type of fire service installation or location, where specified	**System/Equipment requiring the use of Fire Resistant Cables**	**Remark**
Audio/visual advisory system	The power supply/signalling cables to speakers and flashing directional signs from control panel/console and AV equipment.	
Automatic fixed installations using water	The power supply cable from main/sub-main switchboards to electric motor of pumps including transfer and intermediate pumps.	
Automatic fixed installations other than water	The power supply cable from main control panels to fire extinguishing agent actuating devices.	
Emergency generator/Main backup power source	All outgoing power supply cables from emergency generators and other main backup power sources to main switchboards and to main essential power supply boards.	
General emergency lighting except those for cinemas, theatres and scheduled premises	The power supply cable from main switchboards, sub-main boards, central battery supply or other power sources to emergency lighting fittings except for self-contained emergency lighting fittings.	

Type of fire service installation or location, where specified	System/Equipment requiring the use of Fire Resistant Cables	Remark
General emergency lighting for cinemas, theatres and other scheduled premises	The power supply cable from main switchboards, sub-main boards, central battery supply or other power sources to emergency lighting fittings.	
Exit sign	Same as general emergency lighting	
Fire alarm system	The power supply/signalling cables to alarm bells and visual alarm signal units from fire alarm control and indication panels	
Fire detection system	The power supply/signalling cables to audio/visual alarm/detection devices from fire alarm control and indication panels	
Fire hydrant/hose reel system	The power supply cable from main/sub-main switchboards to electric motor of fixed fire pumps and intermediate booster pumps	
Fireman's lift control	The power supply cable from main/sub-main switchboards to traction motors/car lighting/power circuit of lift	
Fixed foam system	The power supply cable from main/sub-main switchboards to electric motor of pumps	
Pressurization of staircases system	The power supply cable from main/sub-main switchboards to electric motor of fans and the Control cable.	
Ring main system with fixed pumps	The power supply cable from main/sub-main switchboards to electric motor of pumps	
Sprinkler system	The power supply cable from main/sub-main switchboards to electric motor of pumps	
Pre-action Recycling Sprinkler system	Heat detector circuit cables from and to the control panel	Also refers to Clause B3.23

Type of fire service installation or location, where specified	System/Equipment requiring the use of Fire Resistant Cables	Remark
Smoke extraction system	The power supply cable from main/sub-main switchboards to electric motor of fans and the Control Cable.	
Water spray system	The power supply cable from main/sub-main switchboards to electric motor of pumps	
Street Fire Hydrant System	The power supply cable from main/sub-main switchboards to electric motor of pumps	
Places of public entertainment	Cables/wirings within the compartment	
Power circuits not covered in other items in this table and installed by the Contractor	Cables from main switchboards to control panels/consoles of various fire service installation	Unless otherwise specified
Hazardous areas/ Dangerous goods stores	Cables/wirings within the compartment	Depend on the hazard zone, 0,1,2. Also refers to Clause B9.13

Except for the hazardous areas, the following are acceptable methods alternative to the use of fire resistant cable for installation work list at Table 3: -

(a) Cables running in trunkings or in cable trays inside fire resistant plant rooms/enclosures of approved fire rating where termination of cables at both ends are located;

(b) Cables running inside concealed steel conduits embedded in plaster/concrete to a depth of at least 12mm;

(c) Cables running inside underground cable ducts and reinforced concrete cable trenches of approved fire rating;

(d) Cables embedded in the soil or solid ground to a depth of at least 300 mm;

(e) Cables running within fire resistant cable ducts and not mixing with other services (e.g. switchgear, etc.) and with fire resistance rating of cables ducts not less than that of the corresponding building compartment.

And the cables in the alternative acceptable methods (a), (b), (c), (d) and (e) shall comply with the following: -

(i) Where cables run within cable ducts/conduits, they shall not be mixed with other services;

(ii) For power cables connecting centrally supplied emergency luminaires, the cables shall be fire resistant cable;

(iii) For power cables to centrally supplied emergency luminaires in cinemas, theatres and other specified premises used for entertainment, the cables shall be fire resistant cable and fully segregated from the general distribution system;

(iv) For power cables to the fireman's lift, emergency generator installation, smoke extraction system, and pressurization of staircases system, the cables shall be fire resistant cable;

(v) For cables to the detection units of pre-action recycling sprinkler system, the cables shall withstand 815^{o}C for at least 30 minutes;

(vi) For power cables from essential power supply switchboards to all kinds of pumps in fire service installation including sprinkler pumps, fixed fire pumps, drencher pumps, street hydrant pumps, jockey pumps, intermediate booster pumps, foam pumps, ring main fixed pumps, transfer pumps etc., the cables shall be fire resistant cable;

(vii) For cables other than the cases in (ii) to (vi), the cables shall be PVC insulated cables complying with General Electrical Specification in concealed steel conduits, or PVC insulated and sheathed steel wire, with or without armour as required, complying with General Electrical Specification in approved fire rated plant room, approved fire rated cable ducts, underground cable ducts or embedded in the soil, or approved products having equivalent performance and function.

B9.12 ELECTRICAL EQUIPMENT IN HAZARDOUS AREAS

The electrical equipment shall depend on the classification of the hazardous areas into zone 0, zone 1 and zone 2 in IEC 60079. Intrinsically safe equipment and materials complying with marking EX ia IIC T5 or EX d IIC T5 to IEC 60079 or approved products having equivalent or better functions and performance shall be used for all zone 0 and zone 1 hazardous areas. Flameproof protective equipment and explosive proof equipment specially approved by a recognised regulatory or approval body for use in zone 0 may be used with the approval of the Architect for zone 0 and zone 1 hazardous areas. For zone 2 hazardous areas, spark-proof enclosure or intrinsically safe equipment complying with marking EX ib or EX e in IEC 60079 or approved products having equivalent or better functions and performance shall be used unless otherwise specified.

Unless otherwise specified, wirings in zone 0 and zone 1 hazardous areas shall be of mineral insulated metal sheathed cable to BS EN 60702 -1:2002 with compatible and explosive proof terminating glands or approved products having equivalent or better functions and performance. Wirings in zone 2 hazardous areas shall be in concealed conduits or of fire resistant cables of appropriate type. Terminations of cables shall use sealing fittings, ground continuity connection or explosive proof seal whichever is appropriate.

All electrical and electronic equipment used in hazardous areas including automatic detectors shall be approved by the Architect and certified by a widely recognised independent regulatory body. The equipment shall bear marking "Ex ia", "Ex d" etc. or have relevant approval documents issued by a widely recognised independent regulatory body. Intrinsically safe electrical and electronic equipment shall also comply with BS EN 50020: 2002 where relevant.

B9.13 SURGE PROTECTION DEVICE

Surge protection device shall be supplied and installed to the electrical supply connecting to the manual and automatic fire alarm installation and other controls in fire service installation. The surge protection device shall incorporate both high energy clamping devices and special filtering circuitry to reduce any electrical surge appearing in the connected electrical system and earth circuit to an acceptable level without causing any damage or malfunctioning to the connected electrical and electronic equipment in fire service installation.

Surge protection device shall be able to give protective performance in all modes, including Phase and Neutral, Phase and Earth, and Neutral and Earth as required. Surge protection device shall be able to withstand repeated electrical surges appeared in the electrical system without undue degradation of its surge protection performance under healthy condition.

Surge protection device shall be manufactured by a reputable manufacturer and it shall be able to meet performance requirements stipulated in General Electrical Specification.

B9.14 LAMPS

All lamps used for exit signs and emergency lighting installation shall comply with Code of Practice for Energy Efficiency of Lighting Installation issued by Electrical and Mechanical Services Department, 2007 Edition, and all subsequent amendments prior to the date of tender return, unless otherwise approved by the Architect.

All lamps for the visual indications on the control and indication panels and repeater panels shall be LED lamps of approved size, brightness and colour unless otherwise specified or approved by the Architect.

SECTION B10

PORTABLE HAND-OPERATED APPROVED APPLIANCES

B10.1 GENERAL

Portable hand-operated approved appliances include fire extinguishers, fixed sprayer units, fire blankets, sand buckets and any other fire service equipment that are used as an independent mean for the purpose of extinguishing, attacking, preventing or limiting a fire. It shall also include the fixed automatically operated approved appliances installed in a room. Only portable appliances in the list approved by the Director of Fire Services will be accepted. All mounting fixtures and labour for installing the appliances shall be provided. Inspection, repair and maintenance of the portable appliances throughout the contract period shall be carried out by a person employed by the Contractor, who shall be a Registered Fire Service Installation Contractor in Class 3 registered with the FSD. Portable hand-operated approved appliances shall comply with FSDCoP and where applicable BS 5306-3: 2003.

The Contractor shall supply and install portable hand-operated approved appliances as required by either occupancy or risk in individual area(s) such as Dangerous Goods Stores, LPG Stores, plant rooms and various licensed premises in accordance with the Laws of the Hong Kong Special Administrative Region and approved by the FSD and the Architect.

The Contractor shall be responsible for the supply, fixing and installation of the portable hand-operated approved appliances. Wall mounting brackets shall be supplied and installed by the Contractor.

Where there are several fixed automatically operated appliances of similar types in a compartment, the Contractor shall, unless otherwise not required by the FSD, supply and install all necessary controls such that the operation of any one unit will cause all similar units within the compartment to operate simultaneously.

Where portable hand-operated approved appliance is installed in public areas, the Contractor shall submit details of the fixing and builder's work requirements for approval with particular attention to the requirements for preventing the appliance from being stolen. Remote monitoring facilities or theft stopper shall be supplied and installed where specified which will be energised when the appliance is lifted up or removed. Portable hand-operated approved appliance located outdoors shall be installed inside a cabinet to the approval of the FSD and the Architect. Where the portable hand-operated approved appliance is installed outdoors, the Contractor shall include details of the cabinet requirement acceptable to the Architect for housing the appliance in the submission of builder's work requirement to the Architect for approval.

B10.2 FIRE BLANKETS AND SAND BUCKETS

Fire blankets and sand buckets shall conform to the requirements of the FSD. Buckets shall be of not less than 10 litres capacity and shall be galvanised steel and painted red. Fire blankets shall comply with BS 7944: 1999 and shall be of FSD approved heavy duty and reusable type.

B10.3 FIRE EXTINGUISHERS

Fire extinguishers shall be rechargeable hand-operated extinguishers complying with FSDCoP and of appropriate type to BS EN 3-7: 2004, NFPA 10: 2007, ISO 7165:1999, BS 5306-3: 2003 and BS 7863: 1996 for water, foam, dry powder, carbon dioxide, NAFS III, FM200 or other approved agent type with a capacity as specified. Foam and powder type extinguishers shall be cartridge operated with a replaceable gas cartridge fitted into the extinguisher. Inverted type fire extinguishers requiring turning upside down before use are not acceptable. All fire extinguishers shall be properly labelled with appropriate instructions of use and with maintenance labels in accordance with FSDCoP.

Fire extinguishers shall be manufactured and tested to recognised international standards. The Contractor shall submit batch-approval certificate, batch-approval certification mark, or other evidence showing that the extinguisher has been batch-approved by recognised bodies or organisation acceptable to the Architect after manufacture. Extinguisher without batch-approval certificate/mark or other approval documents will not be accepted.

Where the type of fire extinguisher is not indicated, the Contractor shall submit the appropriate type of fire extinguisher suitable for the hazard and the occupancy in individual area to the FSD and the Architect for approval.

B10.4 FIXED SPRAYER UNITS

Fixed sprayer units shall be of self-contained automatically operated clean agent or dry powder type fitted with a sprinkler head which activates at 68^{o}C approximately. For rooms fitted with clean agent automatic extinguishers, identification symbols prescribed by the FSD shall be supplied and installed and fixed to each entrance door. The fixed sprayer unit shall be properly labelled with maintenance label in accordance with FSDCoP.

SECTION B11

EMERGENCY LIGHTING, EXIT SIGN AND EMERGENCY GENERATOR

B11.1 EMERGENCY LIGHTING

B11.1.1 General

Emergency lighting shall be provided for the purpose of fire escape in the event of mains power failure.

Emergency lighting for fire escape purpose shall comply with BS5266-1: 2005, BS EN 50172:2004 , BS EN 1838: 1999 and the requirements of the FSD and Building Authority, and shall be backed up by emergency power supply.

Emergency power supply shall be fed from an emergency generator. If the building is not equipped with an emergency generator, the emergency lighting shall be provided with secondary battery supply.

In the event of power failure, the emergency lighting shall be activated within 5 seconds or within such shorter time specified elsewhere in the Specification upon mains power failure in ALL types of buildings. To meet this requirement, emergency lighting shall be provided with secondary battery supply, uninterrupted power supply, or an approved source of backup power supply accepted by the Architect even when they are connected to the emergency generator.

Secondary source of power supply obtained before electrical mains switch is not accepted to be the source of emergency power supply for emergency lighting and so secondary battery supply shall be provided.

In places of public entertainment such as theatres, cinemas etc., other locations such as fire exit staircases, main fire exit routes etc., locations as required by the FSD, and where specified in the Specification, emergency lighting shall be backed up by both emergency generator and secondary battery supply.

Where an emergency generator is provided in a building for fire service installation, all emergency lighting systems with or without battery system shall be connected to and backed up by the emergency generator for fire fighting purpose.

Battery emergency lighting system shall be in the form of centrally supplied emergency luminaires or self-contained emergency luminaires or their combination.

Unless otherwise specified or approved by the Architect, the provision of emergency lighting shall be as follows: -

(a) Battery emergency lighting system, i.e. emergency lighting backed up by battery system, shall be selected and provided where possible. The system shall in addition be backed up by emergency generator for fire fighting purpose when it is available in the building;

(b) Self contained emergency luminaires backed up by emergency generator for fire fighting purpose (when available) shall be provided to fire exit staircases, main switch rooms, security control rooms, fire control rooms, emergency generator rooms, major mechanical plant rooms, building management rooms, switch rooms and control rooms served for essential operation, and locations as required by the FSD, unless otherwise approved by the Architect;

(d) Centrally supplied emergency luminaires backed up by emergency generator for fire fighting purpose (when available) shall be provided to all other areas and divided in zones due to its advantage in centralised testing and inspection unless otherwise specified. The number of emergency luminaires served by one centrally supplied system in a zone shall not be excessive in order to limit the size of the central battery bank. In general, there shall be at least two centrally supplied system on a floor such that alternate emergency luminaires in a row shall be supplied by different centrally supplied systems. For a building with small floor area, it is acceptable to have two centrally supplied systems supplying to more than one floor but emergency lighting on any one floor shall still be supplied in alternate arrangement by the two centrally supplied systems.

(e) For small rooms or spaces remotely located from the main buildings, self-contained emergency luminaires backed up by emergency generator for fire fighting purpose (when available) shall be used in these small remote areas.

(f) When the total number of battery emergency lighting in a building excluding those in the fire exit staircases etc. stated in item (b) above is small (generally less than 30), self-contained emergency luminaires backed up by emergency generator (when available) shall be used.

(g) Any other design or combination approved by the FSD and the Architect.

Emergency lighting system shall be of maintained type or non-maintained type or their combination as required. Emergency lighting in fire exit staircases and main fire exit routes shall be of maintained type.

Other lighting not for the purpose of fire escape shall not be connected to the emergency generator for fire service installation unless otherwise approved by the Architect.

B11.1.2 Lighting Luminaire

All emergency luminaires shall be designed and constructed complying with BS EN 60598-2-22: 1999 or approved products having equivalent and approved construction, functions and performance. The emergency luminaires used in fire escape routes shall also comply with non-flammability (resistance to flame and ignition) provisions in BS EN 60598-2-22: 1999 and their external parts shall be subject to 850^{o}C hot wire test and any burning parts shall self-extinguish within 30 s.

For each enclosed space required to have emergency lighting, there shall be not less than one emergency luminaire unless otherwise approved.

Emergency luminaires shall be capable of operating satisfactorily in the emergency mode at an ambient temperature of 70^{o}C for at least half of its rated duration.

Emergency luminaires shall achieve at least 50% of its rated lumen output at emergency mode in not more than 5 seconds, or within the activation time specified in FSDCoP whichever is shorter, after failure of the normal supply, and shall achieve the rated lumen output at emergency mode in less than 60 seconds after failure of the normal supply. For emergency luminaire requiring an activation time shorter than 5 seconds, the activation time shall be determined by the time for it to achieve 50% or more of its rated lumen output at emergency mode.

The light (lumen) output from emergency luminaire shall be maintained at not less than its nominal level (i.e. rated lumen output at emergency operating mode claimed by the manufacturer) throughout the whole design emergency operating period (i.e. rated duration) except the first 60-second period upon activation. In addition, its light (lumen) output at the end of the rated duration shall not be less than 50% of its maximum light output obtained in the emergency operating mode.

The nominal operating voltage of the emergency lighting system shall be clearly marked and readily identifiable. For centralized systems this shall be either on or adjacent to the control unit of the central batteries and for non-centralized systems this shall be either on or adjacent to the appropriate luminaires. In addition, all emergency luminaires shall be marked with details of the replacement lamps necessary to obtain the performance.

Where self-contained emergency luminaires are identical in appearance to the non-emergency luminaires, suitable labels to the approval of the Architect shall also be attached to the self-contained emergency luminaires for their easy identification during visual inspection.

B11.1.3 Self-contained Emergency Luminaire

Self-contained emergency luminaire shall have adjacent to it or incorporate in it a device for charging the battery from the normal mains supply and an indicator (a charge monitor light) visible in normal use which shows the following conditions: -

(a) The battery is being charged.

(b) Circuit continuity exists through the lamp element.

Where an electrical light source indicator is used, it shall comply with the colour requirements of IEC 60073. When a single indicator provides dual functions, either red or green is acceptable.

Self-contained emergency luminaire shall have a 'TEST' switch for testing purpose and a low voltage cut-out to disconnect the batteries when fully discharged.

Self-contained emergency luminaire shall use sealed, rechargeable, maintenance free nickel-metal hydride (NiMH) batteries when its rated capacity is not more than 30Ah. When the rated capacity is higher than 30Ah, NiMH batteries or sealed lead acid batteries or other batteries having equivalent or better functions and environmental performance approved by the Architect shall be used.

The batteries shall have ample capacity to maintain the output of the emergency luminaires for a period complying with FSDCoP and BS 5266 - 1: 2005 and for at least 2 hours. For sleeping accommodation, and some particular premises specified in BS 5266-1: 2005 or BS EN 50172: 2004 where there is no emergency generator, the duration of battery supply shall not be less than 3 hours.

B11.1.4 Centrally Supplied Emergency Luminaire

The power supply to the centrally supplied emergency luminaires shall be fed from a central battery power supply system. Unless otherwise specified, AC emergency luminaires shall be used. The central battery power supply system shall be capable of providing AC power supply to the emergency luminaires.

The central battery power supply system shall comprise rectifier, automatic trickle charger, inverter, storage batteries, switchgears, controls, meters, regulators, pilot lights, instrumentation and other accessories. It shall supply AC mains power to the emergency luminaires and at the same time charge the storage batteries during the normal mode. During emergency mode, it shall change over to supply power from its storage batteries.

The central battery power supply system shall be designed to operate in the following modes: -

Normal	AC mains supply shall be rectified into regulated DC voltage for float charging the batteries. AC mains supply shall be directed to the emergency luminaires or be used to power the inverter to supply power to the emergency luminaires.
Emergency (AC mains failure)	Upon failure of AC mains supply, the power supply shall be changed over and fed from the storage batteries and inverter. Normal mode shall be resumed after AC mains supply is restored.

Uninterrupted power supply system comprising static transfer switch, synchronizing and phase lock equipment, maintenance bypass switch, storage batteries, charger, rectifier, inverter etc. providing equivalent functions and performance may serve as a central battery power supply system with the approval of the Architect. However, the charger and storage batteries of uninterrupted power supply system shall be specially designed and adequately sized to cater for the operating period of emergency lighting system. In particular, the charger shall be adequately rated and sized to provide the charging performance specified by the battery manufacturer to charge the batteries within 12 hours after a full discharge, or within such shorter time period as specified in FSDCoP, FSD Requirements and Circular Letters, LPC Rules for Sprinkler Installations and LPC Rules for AFA Installations etc.

The central battery power supply system shall be designed to support non-maintained type, maintained type or a combination of both types of emergency luminaires connected to the same central battery power supply system.

The central battery power supply system shall be designed and manufactured by a reputable manufacturer which has continuously manufactured the system for at least 5 years. It shall have a local agent to provide full technical support which includes adequate spare holding policy and technical expertise in testing, commissioning and trouble shooting. The central battery power supply shall be manufactured under recognized international standards of quality assurance programme such as ISO 9001:2000 or EN 50091-2:1995.

A monitoring, control and information panel shall be located on the front of the system cubicle. It shall be capable of acquiring, logging and reporting data, alarms and instruction reflecting the operating conditions of the central battery power supply system and other data required for routine testing, which includes, but not limited to, the following: -

Power Input	Input mains voltage Input current
DC Link	Battery voltage Rectifier output current Battery charge/discharge current Remaining capacity Battery cabinet temperature
Inverter Output	Output voltage Output current Output frequency

The following technical information shall be submitted by the Contractor to the Architect for approval prior to the ordering of equipment: -

(a) Technical catalogues and specification of the central battery power supply system;

(b) Detailed calculation for charger and battery capacity with manufacturer's battery discharge data provided for verification purposes;

(c) Power supply circuit diagram;

(d) Control circuit diagram.

Centrally supplied emergency luminaire system shall use sealed, rechargeable and maintenance free nickel-metal hydride (NiMH) batteries for central battery power supply system when its rated capacity is not more than 50Ah. When the rated capacity is higher than 50Ah, NiMH batteries or sealed lead acid batteries or other batteries having equivalent or better functions and environmental performance approved by the Architect shall be used.

The battery system shall have capacity adequate for maintaining the light output, after mains failure, of all centrally supplied emergency luminaires (maintained type and non-maintained type) at not less than their rated lumen output at emergency operating mode. It shall also be capable to power all maintained type emergency luminaires to give not less than 50% of their design light output at normal mains supply during emergency operating mode.

The battery system for centrally supplied emergency luminaire shall have ample capacity to maintain the output of all connected emergency luminaires for a period complying with FSDCoP and BS 5266-1: 2005 which is for at least 2 hours in cinemas, theatres, scheduled premises, and buildings without emergency generators, and for at least fifteen (15) minutes in other buildings with emergency generators. For sleeping accommodation and some particular premises specified in BS 5266-1: 2005 and BS EN 50172: 2004 with no emergency generator, the duration of battery supply shall not be less than 3 hours.

The battery system shall be designed to operate at voltage not less than 24V and not more than 120V DC.

B11.1.5 Testing Facilities

Emergency lighting system shall have suitable means for simulating failure of the normal supply for test purpose.

For centrally supplied emergency luminaire system, testing facilities shall be supplied and installed for the following tests: -

(a) Weekly voltage test for the battery and, where applicable, hydrometer test;

(b) Monthly discharge test of 1 minute at 10-hour discharge rate;

(c) Annual lamp test for at least half of the rated duration;

(d) Lamp test for full rated duration in every three years.

For self-contained emergency luminaire, testing facilities (either in the form of an integral test facility or by connecting the luminaire to a remote testing facility) shall be supplied and installed for the following tests: -

(a) Monthly discharge test of 1 minute at 10-hour discharge rate;

(b) Annual lamp test for at least half of the rated duration;

(c) Lamp test for full rated duration in every three years.

B11.1.6 Battery and Charger

The battery charger shall be compatible with the battery system. It shall provide the rated charging performance specified by the battery manufacturer to charge the batteries within 12 hours after a full discharge, or within such time period specified in FSDCoP, FSD Requirements and Circular Letters, LPC Rules for Sprinkler Installations and LPC Rules for AFA Installations etc. whichever is shorter. Central battery power supply system shall use automatic trickle charger. The battery charging system and the power circuit shall be designed to prevent frequent and rapid charging and discharging of the batteries thus shortening their lives.

Charging of batteries in luminaires shall not be affected or interrupted under normal operation even when the luminaire is switched off.

Transformers for charging the batteries shall comply with relevant requirements stipulated in IEC 60742.

The batteries shall be designed to comply with BS EN 60598-2.22 and shall have a design operating life of not less than 4 years under normal operation, i.e. at the end of four years operation at normal charging and discharging, the batteries shall still be capable of supplying the rated capacity and serving the rated duration, i.e. the design emergency operating period.

The battery and charger for the centrally supplied emergency luminaire system shall also comply with Clause B8.10 where relevant.

B11.1.7 Central Monitoring, Testing and Logging System

Central monitoring, testing and logging (CMTL) system refers to all kinds of automatic, self-testing or remote system for monitoring, testing and logging of the performance of self-contained emergency luminaires in regular test of the emergency lighting installation during operation.

Automatic CMTL system shall have a central computer unit to monitor the status and routine automatic testing of all self-contained emergency luminaires connected to it. Self-testing system shall have built-in facilities to test the emergency luminaires automatically at scheduled intervals and to generate a local alarm or warning if it fails to pass the test. Remote system can initiate a test for self-contained emergency luminaire without physically reaching it which can be used for testing of luminaires installed at high level. Failure of CMTL system shall not affect the functioning of emergency luminaires.

Unless otherwise specified, the Contractor shall supply and install Central monitoring, testing and logging system to all self-contained emergency luminaires in a building to facilitate regular monitoring where the total number of self-contained emergency luminaires in a building excluding those located inside the fire exit staircases separated by fire doors exceeds 50 numbers, or where the total number of self-contained emergency luminaires located at fire exit staircases exceeds 50 numbers. Where the type of CMTL system is not specified, automatic CMTL system shall be adopted.

Automatic CMTL system shall have the facilities to communicate with the luminaires and register failures from a remote location. Each luminaire shall be assigned with a unique address and the CMTL system shall have a minimum capacity of communicating with all the connected luminaires, plus at least 20% spare capacity for future expansion. It shall be a fully automated microprocessor based system providing detailed testing and logging of all emergency luminaires. Tests can be programmed at specified dates and times to suit the end user's requirements. The central computer unit in automatic CMTL system shall also comply with relevant requirements under the section of central control and monitoring system in General A/C Specification.

The Contractor shall be responsible for the design of CMTL system to perform all routine test functions automatically with minimal labour. The Contractor shall then select proper, correct and compatible equipment and components to achieve the performance specified in the design. Detailed design as well as full technical information of the system shall be submitted to the Architect for approval prior to ordering and installation.

In selecting the makes and types of equipment, the Contractor shall ensure that servicing facilities and replacement spare parts can be available locally within 3 calendar days for future maintenance of the system.

CMTL system shall have the capability to initiate all weekly, monthly and annual tests required in FSDCoP, FSD Requirements and Circular Letters.

The Contractor shall provide adequate and separate training courses to not less than four persons nominated by the Architect to enable them to understand and familiarise with the use, maintenance, programming and re-programming of the CMTL system. Details and the proposed training programme shall be submitted to the Architect for approval. The training shall be conducted during normal working hours by approved trainers of the manufacturer unless otherwise approved by the Architect. The training shall be so designed that after completion of the course, the trained persons shall be able to carry out all the functions for monitoring, testing and data logging. A certificate/ acceptance letter shall be issued by the manufacturer of the CMTL system or the manufacturer's approved agent stating that they are satisfied with the ability of the trained persons to operate and modify the programs of the CMTL system without affecting system operation.

The Contractor shall allow in their offer labour and cost for modifying the computer programme in the automatic CMTL system for at least two times during the Maintenance Period after the acceptance of the system in order to suit end user's requirements.

B11.1.8 Wiring for Emergency Luminaire

The installation shall comply with BS 5266-1: 2005, BS EN 50172: 2004, BS 7671: 2001 and all relevant requirements in Section B9. The wiring shall also comply with the licensing requirements of scheduled premises where applicable.

All wirings for emergency luminaires, battery sets and other equipment for emergency lighting installation shall commence from dedicated power supply point(s) as shown on the Drawings, or from the mains supply where dedicated power supply point is not indicated.

B11.1.9 Segregation

The wiring of escape lighting installation (emergency lighting installation for fire escape purpose) shall be exclusive to the installation and separate from the wiring of any other circuits, either by installation in a separation conduit, trunking, or by separation from the conductors of all other services by a mechanically strong, rigid and continuous partition of non-combustible material. Any metal partition shall be electrically earthed to BS 7671: 2001.

B11.1.10 Isolators, Switches and Protective Devices

Every isolator switch, protective device, key operating device in the emergency lighting installation shall be marked "EMERGENCY", "ESCAPE" or "STANDBY LIGHTING" as appropriate and the marking shall indicate its use. Details shall be submitted to the Architect for approval.

B11.1.11 Electromagnetic Compatibility

Emergency lighting systems shall be designed and installed such that they do not cause electromagnetic interference, in accordance with EMC Directive 89/336/EEC.

B11.1.12 Certifying Emergency Lighting Installation and Exit Sign not included under Fire Service Installation

Where indicated that there are emergency lighting installation and exit signs in the same building by others and not included in the Works under Fire Service Installation but they are to be inspected by the FSD, the Contractor shall include such emergency lighting installation and exit signs by others in the submission to the FSD as part of the fire service installation with the necessary information to be provided by the relevant parties.

The Contractor shall co-ordinate with relevant installation parties, inspect, check and witness the final functional and performance tests on such emergency lighting installation and exit signs by others to identify any non-compliance with the requirements in FSDCoP, FSD Requirements and Circular Letters, FS_TC and EE_TC for the purpose of certifying the satisfactory conditions of the emergency lighting installation and exit signs. Any works found not complying with fire service requirements of the FSD shall be rectified by the Contractor when the emergency lighting installation or exit sign is included in the Works, or be reported to the Architect when such works are installed by others, before arranging inspection with the FSD. Upon witnessing the satisfactory completion of all final tests and inspections after rectification of non-conformities related to fire service, the Contractor shall certify such emergency lighting installation and exit signs by others taking the role as a registered fire services installation contractor for them. The Contractor shall then arrange inspection by the FSD on all fire service installations in the building including emergency lighting installation and exit sign by others.

For the purpose of fire service inspection, the emergency lighting installation referred in this clause shall be limited to those required by the FSD and the Building Authority and shall not include emergency lighting installation solely designed for user's operation at mains power failure.

The Contractor shall also collect information from relevant installation parties and include emergency lighting installation and exit signs by others in submissions such as Form 314 to the FSD prior to the installation.

B11.2 EXIT SIGN

Exit sign shall conform to BS 5499-1: 2002, BS 5499-4: 2000, BS EN 60598-1: 2004, BS EN 60598-2-22: 1999, BS 5266-1: 2005, BS EN 50172: 2004 and BS EN 1838: 1999 unless otherwise specified. Exit sign shall also comply with the requirements in FSDCoP and MoE. Exit sign shall be visible and conspicuous from any position within the premises to ensure that exit routes can be easily recognised and followed in an emergency and in fire and smoke conditions. The provision of exit sign shall deem to include all related directional signs or series of signs for the exit routes as specified in Clause 4.2 in BS EN 50172: 2004 to assist progression towards the exit as indicated by the exit sign.

To ensure the visibility and conspicuousness of the exit sign at all times including fire and smoke conditions, exit signs shall conform to all the following requirements as the minimum: -

(a) Exit signs shall be internally illuminated bearing the words "EXIT 出口" in block letters and characters of not less than 125mm high with 15mm wide strokes. Colour contrast for translucent surrounds to lettering shall be either one of the following combinations or as specified: -

Colour	Contrasting Colour
Green	White
White	Green

The colour combination selected shall be consistent throughout the same building. The colour shall not deteriorate or become faint throughout the service life and lasts for at least ten years.

(b) The viewing distance of exit sign shall be not less than 25 m under ambient no smoke condition with and without normal lighting. The words shall be easily legible. Uniformity of luminance is the critical factor. The ratio of the maximum to the minimum luminance within either white or green colour area shall be not greater than 10:1.

(c) The exit sign shall be easily visible and conspicuous in fire and smoke conditions. The viewing distance shall not be greatly reduced in the presence of smoke. Brightness of exit sign is the critical factor for visibility in fire and smoke conditions. The exit sign shall produce an average luminance of not less than 100 cd/m^2 unless otherwise specified. The ratio of the luminance at white area of the exit sign to the luminance at green area shall be not less than 5:1 and not greater than 15:1.

For exit sign of lower average luminance but which is capable of achieving equivalent or better viewing distance, visibility and legibility as the 100 cd/m^2 fluorescent exit sign in smoke condition (at optical density not less than 1 m^{-1}) with and without normal lighting, test reports carried out and certified by approved independent laboratory/testing body shall be provided for substantiation and approval.

The exit sign shall be capable of operating satisfactorily in the emergency mode at an ambient temperature of 70^{o}C for at least half of the rated duration in emergency mode as specified in EN 60598-2-22.

The average luminance of the exit sign shall not decrease by more than 30% of its initial design value throughout its rated life in continuous operation when operated at ambient temperature between 5^{o}C and 40^{o}C.

Where it is shown on the Drawings that a sign cannot be installed immediately above an exit or when an exit sign is not easily visible from all positions within the premises served by the exit sign, additional internally illuminated directional signs or other signs conforming to BS 5499-1: 2002, BS 5266-1: 2005 and BS EN 50172: 2004 shall be supplied and installed at conspicuous locations to indicate the route to the exit. The graphic design of directional sign shall conform to FSDCoP, FSD Requirements and Circular Letters.

For illuminated exit signs supplied and installed in places like theatres, cinemas, etc. and other specified premises used for entertainment with normal operation and performance mostly conducted in dark environment, the maximum luminance of any patch on the exit sign shall not exceed 80 cd/m^2. The average luminance shall however be not less than 25 cd/m^2. In addition, the size of the wording of the exit sign in English and Chinese shall not be less than 175mm. Adequate number of exit signs and directional signs shall be provided in these places to enable the signs indicating the exit routes and progressing towards the exit to be seen at all positions. Where approved, exit signs can have built-in lamps with two-stage controls providing different illumination level for normal and dark environment. Black and green exit signs shall not be used except with the approval of the FSD and the Architect.

Exit sign shall be safe in construction and use. It shall not create any harmful effect and not generate any additional risk and liability to the building occupants, workers, public visitors during the whole period of use.

The construction details, finishes, appearance and performance data of exit signs shall be submitted to the Architect for approval before fabrication. The Contractor shall allow modifying the appearance and details of the exit signs to the satisfaction of the Architect.

Illuminated exit signs shall be connected to the mains supply, and to the emergency power supply where available in the building and where indicated. All wirings for the exit signs commencing from the power supply points as shown on the Drawings shall be supplied and installed by the Contractor.

The luminaires for exit signs shall be of type for maintained operation. The number of lamps for each internally illuminated sign shall be not less than two. The failure of one or more lamps shall not interrupt the charging current to the battery and shall not cause an overload.

Where fluorescent lamp is used as the light source for exit sign, energy saving T5 fluorescent lamps or fluorescent lamps demonstrated to be equivalent or better in terms of functions and performance shall be provided. Where LED emitter is used as the light source for exit sign, the input current to each LED emitter shall be set at no more than the manufacturer's recommended design value for continuous operation in order to achieve the rated operation life. Exit sign shall be manufactured under quality control standard such as ISO9000/9002 or equivalent and approved.

Self-contained exit signs shall be provided with secondary battery(s). Centrally supplied exit signs shall be connected to the central battery set of emergency lighting installation provided on the same floor or in the same premise.

Where batteries are provided, the design operating life of the batteries shall be not less than four years. In emergency mode without mains and emergency power supply, the batteries shall be capable of maintaining the operation of exit signs and related directional signs for not less than the period specified for emergency lighting installation in Clause B11.1 and in any case shall be not less than 2 hours after mains failure.

The battery, battery charger, wiring, testing facilities, automatic changeover switch, accessories and related provisions of exit signs shall comply with relevant requirements of emergency lighting installation and the requirements as specified in Clause B11.1, BS 5266-1: 2005, BS EN 50172: 2004 and BS EN 1838: 1999. Internal wiring and electronic circuits shall be protected from excessive current that may occur during fault conditions by incorporation of safety devices between the batteries and the electronic circuits. There shall be no switch between the batteries and the emergency lighting lamps other than the changeover device. Changeover from normal to emergency supply mode shall be set at 0.85 times rated supply voltage or below.

B11.3 EMERGENCY GENERATOR

Emergency generator for fire service installation shall comply with relevant requirements as specified in the General Electrical Specification for diesel generating set and in the Particular Specification, and certified by a Registered Professional Engineer in Hong Kong under CAP 409 in approved disciplines (or equivalent approved professional qualification) employed by the Contractor. The Contractor shall be responsible to carry out all tests to the satisfaction of the Architect and the FSD on completion of the installation.

Emergency generator for fire service installation is also one type of electrical installation. The Contractor shall arrange all works to be carried out by registered company and workers in accordance with the statutory regulations for electrical installation. Certificates/forms duly signed by the Contractor and the Contractor's Registered Electrical Workers shall be submitted to the Architect upon completion of the works. The whole emergency generator installation shall also be checked and certified by the Registered Professional Engineer.

The Contractor shall only assign trained workers to work on the fuel oil or diesel installation of the emergency generator. Requirements of dangerous goods store shall be complied where relevant. The Contractor shall be responsible for necessary submission and co-ordination in obtaining the licence for the dangerous goods store as required. The Contractor shall ensure that all mechanical and movable parts of the emergency generator installation are lubricated and balanced, and the controls are accurately set on completion.

The Contractor shall provide acoustic treatment to the emergency generator installation and its exhaust and air intake points so that the noise level shall be kept below the requirements of Environmental Protection Department or as specified in the Particular Specification whichever is the lower. The position of exhaust and its height shall also comply with the requirements of Environmental Protection Department. Unless the provision of acoustic treatment by others is explicitly indicated on the Drawings, the Contractor shall take that no acoustic treatment will be provided by others in the building works.

Where indicated that there is emergency generator installation in the same building by others and not included in the Works under Fire Service Installation but it is to be inspected by the FSD, the Contractor shall include such emergency generator installation by others in the submission to the FSD as part of the fire service installation with the necessary information to be provided by the relevant parties.

The Contractor shall co-ordinate with the relevant installation parties, inspect, check and witness the final functional and performance tests on the emergency generator installation by others, including the load test of fire service installation and equipment using the emergency generator power supply, to identify any non-compliance with the requirements in FSDCoP, FSD Requirements and Circular Letters, FS_TC and EE_TC for the purpose of certifying the satisfactory conditions of the emergency generator installation and its interfacing with fire service installation. Any works found not complying with the fire service requirements of the FSD shall be rectified by the Contractor when they are included in the Works, or be reported to the Architect when such works are carried out by others, before arranging inspection with the FSD. Upon witnessing the satisfactory completion of all final tests and inspections after rectification of non-conformities related to fire service, the Contractor shall certify such emergency generator installation by others taking the role as a registered fire services installation contractor for it. The Contractor shall then arrange inspection by the FSD on all fire service installations in the building including emergency generator installation.

For the purpose of fire service inspection, the emergency generator installation referred in this clause shall be limited to the one required by the FSD and shall not include emergency generator installation solely designed for user's operation at mains power failure.

The Contractor shall also collect information from relevant installation parties and include emergency generator installation by others in submissions such as Form 314 to the FSD prior to the installation.

During the test on emergency generator installation, the Contractor shall co-ordinate and check that all fire service installations and equipment, fireman's lifts, and RFSI requiring emergency power supply at the time of fire outbreak and power interruption are all tested to operate on emergency power.

The emergency generator shall have a minimum continuous full load rating of not less than the consumption of all fire service installations and equipment, fireman's lifts, and RFSI connected thereto. A separate dedicated emergency generator supplying emergency power to the fire service installation, fireman's lifts, and RFSI is required. Emergency generator shall not be connected to other non-fire service essential electrical load without the approval of the FSD and the Architect. The emergency generator for fire service installation shall be housed in separate room independent from the emergency generators supplying other essential electrical load unless otherwise approved.

Where the emergency generator for fire service installation is accepted by the FSD for supplying other essential electrical load, the Contractor shall supply and install visual and audible warnings on the generator control panel, fire service control panel, and fire service repeater panels in management offices to give warning at low fuel level when the total fuel storage for supplying the fire service equipment, fireman's lifts and RFSI is less than 7.5 hours supply. When the fuel storage is below the 6.5-hour minimum supply requirement, the emergency generator installation shall have facilities to cut off all non-fire service electrical load connected to the emergency generator with visual and audible warnings. Non-fire service electrical load shall also be tripped off in case of the failure of the control system or visual and audible warning system when a fire alarm signal is activated. All control relays, contactors, and auto-changeover switches for the control system and visual and audible warning system shall be installed in a control panel inside the generator room. Fire resistant cables complying with Clause B9.9 shall be used for the control and signal circuits.

The Contractor shall fix appropriate notice and sign inside the emergency generator room and main switch room in accordance with FSDCoP to indicate the total essential electrical loading of fire service installations and equipment, fireman's lifts and RFSI connected to the emergency generator.

B11.4 INSTALLATION AND CERTIFICATION

The Contractor shall employ Registered Electrical Workers of appropriate grades in accordance with the Electricity Ordinance to carry out the emergency lighting, exit sign and emergency generator installation. All relevant certificates/test reports shall be duly signed by the Contractor and the Contractor's Registered Electrical Workers and submitted to the Architect for record. Where specified, the Contractor shall also have Registered Professional Engineer certifying the works and the record shall be submitted to the Architect.

SECTION B12

MECHANICAL, SPECIAL AND RELATED FIRE SERVICE INSTALLATIONS

B12.1 MECHANICAL FIRE SERVICE INSTALLATION

Mechanical fire service installation shall include ventilation/air conditioning control system, pressurization of staircases system, smoke extraction system and automatic actuating devices. Details of each system can be found in Clause B12.2 to Clause B12.5 below.

All works for the mechanical ventilation system, smoke extraction system and pressurization of staircases system in the buildings shall be carried out by a contractor registered both with the FSD and with the Building Authority complying with the statutory regulations.

The Contractor shall employ a Registered Professional Engineer in Hong Kong under CAP 409 in building services or mechanical discipline (or equivalent approved professional qualification) who emphasizes on and is specialized in mechanical ventilation and air handling installation to the approval of the Architect to carry out the design and supervision of the submission, installation and testing of the pressurization of staircases system and smoke extraction system.

All linings for acoustic, thermal insulation and decorative purposes in ducting and piping shall be of Class 1 or 2 rate of surface spread of flame complying BS 476-7: 1997, or brought up to the required standard by the use of an approved fire retardant product.

Where indicated that there are some portions or systems of the mechanical fire service installation in the same building by others and not included in the Works under Fire Service Installation but it is to be inspected by the FSD, the Contractor shall include such mechanical fire service installation by others in the submission to the FSD as part of the fire service installation with the necessary information to be provided by the relevant parties.

The Contractor shall co-ordinate with relevant installation parties, inspect, check and witness the final functional and performance tests on mechanical fire service installation by others to identify any non-compliance with the requirements in FSDCoP, FSD Requirements and Circular Letters, and FS_TC for the purpose of certifying the satisfactory conditions of the mechanical fire service installation and its interfacing with fire service installation and other building services installations. Any works found not complying with fire service requirements of the FSD shall be rectified by the Contractor when the mechanical fire service installation is included in the Works, or be reported to the Architect when such works are installed by others, before arranging inspection with the FSD. Upon witnessing the satisfactory completion of all final tests and inspections after rectification of non-conformities related to fire service, the Contractor shall certify such mechanical fire service installation by others taking the role as a registered fire services installation contractor for it. The Contractor shall then arrange inspection by the FSD on all fire service installations in the building including mechanical fire service installation by others. The Contractor shall also collect information from relevant installation parties and include mechanical fire service installation by others in submissions such as Form 314 to the FSD prior to the installation.

B12.2 VENTILATION/AIR CONDITIONING (VAC) CONTROL SYSTEM

Unless otherwise specified, ventilation/air conditioning control system required by the FSD shall be included in the Works under Fire Service Installation. The Contractor shall co-ordinate on the interfacing of the VAC control system with the relevant parties held responsible for the ventilation and air conditioning installation works and submit the drawings to the Architect and to the FSD for approval giving all details of the installation works including:

(a) Flow rate of each ventilation fan;

(b) Ventilation fans required to be tripped off;

(c) Method used to trip off the fans;

(d) Location of manual stop switch;

(e) Schematic diagram showing air side arrangement;

(f) Operating principles for tripping the fans; and

(g) Location and layout of indication/control panel, or if any, interconnection with fire alarm control system.

The Contractor shall co-ordinate with the relevant parties held responsible for the ventilation and air-conditioning installation works to obtain the necessary information and schematic diagram on ventilation and air conditioning installation such that the Contractor is able to provide in the submitted drawings all details of the installation works as stipulated hereinabove.

The VAC control system shall be of fail-safe design. A bypass key switch with visual and audible warnings in the panels shall be included for isolating the VAC control system temporarily during routine maintenance fire alarm testing. Three keys shall be provided.

Where required by the FSD and approved by the Architect, activation of detectors provided solely for the VAC control system shall not sound the general fire alarm and shall not send the fire signal via the fire alarm direct link and alarm transmitter. However, an alarm with visual and audible warnings shall be provided on the control panels.

B12.3 PRESSURIZATION OF STAIRCASES SYSTEM

Where indicated that pressurization of staircases system is included in the Works under fire service installation, the Contractor shall design, supply and install the system. The pressurization of staircases system shall comply with the requirements in FSDCoP, FSD Requirements and Circular Letters, BS EN 12101-3: 2002, BS 5588-4: 1998 and where appropriate BS EN 12101-6: 2005. The Contractor shall submit the design, drawings and the calculation of the pressurization of staircases system to the Architect and to the FSD for approval giving all details confirming compliance with the FSDCoP, operating principles, schematic diagram, layout, control and catalogues on the door sets and other equipment. The Contractor shall indicate the relationship between the pressures in various parts of the building especially in areas provided with air conditioning and the pressure in the staircase.

Where part or whole of the system is carried out by others and not included in the Works under Fire Service Installation, the Contractor shall co-ordinate with the relevant parties, inspect, check and witness the final tests to identify any non-compliance with FSDCoP, FSD Requirements and Circular Letters, and to verify the system meeting the functional and performance requirements. Any works found not complying with the fire service requirements of the FSD shall be rectified when they are included in the Works or be reported to the Architect when such works are carried out by others before arranging inspection with the FSD. The Contractor shall include the pressurization of staircases system in the submission to the FSD with the necessary information to be provided by the relevant parties.

The Contractor shall co-ordinate on various parts of the works particularly on the co-ordination of the builder's portions e.g. door frames and closers etc., the mechanical portions e.g. fans etc. and electrical portions e.g. cables etc. to ensure the system meeting the functional and performance requirements.

(a) The compartment to be protected and the location of pressurization of staircases fans / equipment shall be as indicated on the Drawings. The layout of ductwork and associated accessories shown on the Drawings are indicative. The Contractor shall be responsible for the design of the complete system according to the assessment of the final resistance and with allowance for adjustment, based on the actual duct run and the effects on performance with respect to the offered equipment used for the system.

(b) The Registered Professional Engineer employed by the Contractor for the pressurization of staircases system shall arrange all submissions including all necessary forms, drawings and technical information to the FSD for the consent and inspection of pressurization of staircases system installation. The submission shall include all necessary schematic diagrams required to fully explain the operation of the installations including at least information on "normal", "fire", and "no power" modes with full co-ordination with other services. The Registered Professional Engineer shall sign and certify on the submission that the entire system has been properly designed, selected, tested and checked, and that all components, materials and workmanship comply fully with the requirements of FSDCoP, BS EN 12101-6: 2005 - "Smoke and heat control systems. Specification for pressure differential systems. Kits" and the FSD Requirements and Circular Letters.

Notwithstanding that the Contractor demonstrates the whole system will perform to the standard requirements via numerical calculation to the satisfaction of the Architect and the FSD, the Contractor shall be responsible for ensuring that the system under test does in fact perform in accordance with the Specification with fire compartment be maintained at all times.

The Contractor shall supply and install all components necessary for full operation of the system in automatic or manual mode regardless of whether such components are specified or not. The pressurization of staircases system shall be able to maintain minimum pressurization level at 50 Pa minimum inside the stairwell with all doors closed and all pressure relief systems remain operating. The maximum pressurization level shall be maintained such that under no circumstances shall the combined force, to overcome the pressure differential across any door and the action of the door closer, exceed 100 N or a figure agreed by the FSD when applied at the door opening handle or push plate position. The pressurization of staircases system shall maintain air flow through the open door of air velocity not less than the requirement in FSD Circular Letter No. 2/2006 and BS 5588-4: 1998 for various system classes, or a figure agreed by the FSD during the open door situation. The number of open doors shall be as required by the FSD.

(c) The Contractor shall supply and install pressurization fans as shown on the Drawings and where required to satisfy the pressurization requirements. For buildings with more than one pressurized staircase, duplicate motors for each fan shall be supplied and installed. The pressurization fans shall have variable flow control such that the pressurization requirements can be met within a period accepted by the FSD of a door being opened or closed.

When the pressurization fan is not installed inside a separate fire resistant plant room or when the plant room contains other services installations, the fan and motor assemblies shall be enclosed by fire resistant enclosure with a FRP not less than that of the staircase served.

The nominal motor for the ventilating fans (extraction or make-up) shall provide rating of minimum 20 % higher than the motor operating power input under nominal operating requirement. The motor windings shall be insulated to permit motor operation at design conditions for a period of 1 hour in an ambient temperature of 250 °C.

(d) Unless otherwise specified, the Contractor shall supply and install pressurization ductwork, the associated fittings for the pressurization of staircases system and the associated fire resistant enclosure. Unless otherwise specified, the fabrication and testing of all ductworks shall conform to DW 143 & DW 144 and the requirements stipulated in this General Specification. All ductwork shall be fabricated from galvanised sheet steel and aluminium sheets shall not be accepted.

All pressurization ductwork installed outside the pressurized staircase shall be enclosed by fire resistant enclosure with a fire resistance period not less than the compartment served. Another arrangement is for the ductwork section installed inside the designated plant room for pressurization of staircases system, which is protected from other areas by fire resistant enclosure (including self-closing door) and contains no other services.

(e) The power supply for the pressurization of staircases system shall feed from the building normal and essential supply sources fully comply with the requirements of the FSD. The Contractor shall ensure that all wiring, cables, electrical equipment, starters relays, controls etc shall be suitable for continuous operation at not less than 250 °C ambient for 1 hour. Where the motor control panel is used in serving the pressurization of staircases plants, the motor control panel shall be a type tested cubicle form constructed to BS EN 60439-1: 1999 from not less than 2 mm thick panel steel. All sub-distribution boards, all wirings and cables etc. shall be installed inside a room or enclosure having a FRP of not less than 2 hours and containing no other equipment.

(f) All systems shall be automatically actuated whenever any fire service installation in the building is activated and shall remain in operation until manually reset. Visual indication and audible alarm shall be supplied and installed on the control panel. Actuation of all systems shall be directed from the fire alarm control system whenever that panel transmits a "Fire" signal. Dry contacts shall be provided for transmission of "Fire" signal in the actuation of the pressurization of staircases system. The installations for all out-going wirings and associated accessories connected between these dry contacts to the motor control panel of pressurization of staircases system shall meet FSD’s latest requirement.

When in "fire" mode, the pressurization of staircases system shall not be controlled or under the influence of any other services and systems including the building management or automation system nor shall failure or close down of such systems prevent its operation. However, such systems may monitor the operations as required.

Each system shall be provided with a manual on / off control switch and indicator light at the fire control panel. The indicator lights to show manual on or off operation shall be provided with a red bezel and be flashing. Those indicating lights showing satisfactory operation of the fan(s) shall have a green bezel and be a steady light.

In each pressurization of staircases system fan intake duct, a smoke sensor shall be installed which, when sensing the passage of smoke, shall override all other controlling devices, and shut down the fan of the pressurization of staircases system.

Pressure sensors in the pressurized space shall be suitable for normal ambient conditions i.e. not less than 40°C and 99 % R.H. All wirings used in connecting the pressure sensors shall be of high temperature grade P.V.C. to BS 6007: 2006 (minimum 135°C). The cables shall run in either galvanised conduit within the pressurized space in fire resistant duct or embedded in concealed steel conduit as close as possible to the face of the wall in the space. The pressure sensors and associated equipment used in pressurization of staircases systems shall be of industrial process grade to BS EN 60654-4: 1998. Commercial quality for heating, ventilation and air-conditioning equipment shall not be accepted.

Barometric pressure relief damper shall be supplied and installed for the pressurization of staircases system for over-pressure relief. The framework of dampers shall be 3.2 mm minimum stainless steel sheet formed into a rigid channel section.

B12.4 SMOKE EXTRACTION SYSTEM

Where indicated that the smoke extraction system is included in the Works under fire service installation, the Contractor shall design, supply and install the system. The smoke extraction system shall include static smoke extraction system and dynamic smoke extraction system. The smoke extraction system shall comply with the requirements in FSDCoP, FSD Requirements and Circular Letters, and with the international standards acceptable to the Architect. The Contractor shall submit the design, drawings and the calculation of the smoke extraction system to the Architect and to the FSD for approval giving all details confirming compliance with the FSDCoP, operating principles, schematic diagram, layout, control and catalogues. The Contractor shall indicate the relationship between the pressures and flow in various parts of the building during fire scenarios. Where necessary, the Contractor shall use performance based fire engineering approach in the analysis, simulation and calculation.

Where part of the system or the whole of the system is carried out by others and not included in the Works under Fire Service Installation, the Contractor shall co-ordinate with the relevant parties, inspect, check and witness the final functional and performance tests to identify any non-compliance with FSDCoP, FSD Requirements and Circular Letters, and to verify the system complying with the functional and performance requirements. Any works found not complying with the fire service requirements of the FSD shall be rectified when they are included in the Works or be reported to the Architect when such works are carried out by others before arranging inspection with the FSD. The Contractor shall include the smoke extraction system in the submission to the FSD with the necessary information to be provided by the relevant parties.

For static smoke extraction system, the Contractor shall co-ordinate with relevant parties on the building design to provide the required smoke reservoirs, automatic smoke/fire vents and necessary smoke discharges. Fixing of the smoke curtains shall be by approved means to the recommendation of the manufacturers, complying with the fire service requirements and to the approval of the Architect.

For dynamic smoke extraction system, the Contractor shall supply and install systems most appropriate to the occupancy and the function of the concerned areas. Where smoke extraction system is provided only to part of the building, the Contractor shall adopt the worst case scenarios in the calculation on the effect of air-conditioning and ventilation fans in various parts of the building.

The smoke extraction system shall comply with the following: -

(a) The Contractor shall be responsible for the complete design and installation of the system, and have the system well co-ordinated with other parties. The Registered Professional Engineer employed by the Contractor for the smoke extraction system shall arrange the submissions to the Architect and the FSD for the consent and inspection of the smoke extraction system installation. The submission shall include all necessary forms, drawings and technical calculation / information required to fully explain the full operation modes including at least information on "normal", "fire", and "no power" conditions. The Registered Professional Engineer shall sign and certify that the entire systems have been properly designed, selected, tested and checked by him, and all components, materials and workmanship shall comply fully with the requirements of the smoke extraction system as stated in the FSD’s latest requirements.

Notwithstanding that the Contractor demonstrates by calculation to the satisfaction of the Architect that the system will perform to the standard required, the Contractor shall be responsible for ensuring that the system, under test at any time, does in fact perform in accordance with the Specification.

The smoke extraction system shall be able to maintain the smoke travel at counter-flow mode and away from that of the egress/escape route. Within the protected fire compartment, the make-up air and smoke extraction paths shall be arranged such that a "scouring" or "cross-flow" effects occurs in all areas. The supply of make-up air shall enter at low level and / or in such a manner as to avoid premature mixing with the hot gases. Whenever the make-up air is not mechanically propelled, the air path shall be as directly with shortest route as possible. The points of smoke extraction shall be at high level in the space concerned and shall be reasonably distributed such that the smoke shall not be travelled at more than 30 m before entering the nearest inlet of the extraction system, and at least one extraction point shall be supplied and installed within each 500 m^2 unit of floor area.

The Contractor shall supply and install suitable types of supply diffusers / extraction grilles / louvers etc. to maintain maximum velocities as follows, calculated using free area: -

(i) Make-up air inlets where not mechanically propelled 3 m/s

(ii) Make-up air inlets where mechanically propelled 6 m/s

(iii) Extraction grilles or outlets 6 m/s

The Contractor shall maintain minimum supply or make-up air rate at minimum 80 % of the overall extraction rate. When supply or make-up air is provided by mechanical means, this shall be supplied by an independent supply air system. Where it is acceptable to use normal air conditioning system to supply the make up air, the Contractor shall supply and install facilities to the air conditioning system such that the system can be changed over during fire from the normal operating mode to that extracting full outside air to the required compartment.

The Contractor shall ensure that all system and installation are fail-safe to maintain free passage of smoke with all equipment / components necessary for the full operation of system under automatic or manual mode regardless of whether such equipment / components are specified or not.

(b) Smoke Extraction / Supply Air Fan

The Contractor shall supply and install smoke extraction and supply air fans which shall meet all specified requirements including construction, capacity, efficiency, motor size, sound rating, and constraints on physical dimensions as may be imposed by the design and to suit the smoke extraction requirements.

All smoke extraction fans shall be constructed or coated with finishing materials capable of withstanding exposure to an ambient temperature of at least 250 °C for a period of not less than 1 hour, without producing smoke or any sort of toxic fumes. The respective manufacturer shall certify with substantiation that such coating finishes shall be factory-applied with specified requirement complied. The fans shall be connected directly to outside by non-combustible ductwork including flexible connection, if installed. When smoke extraction / make-up air fans are installed within the served compartment, the system including fans, motors, drives, electrical works, ductwork linking fans etc. shall be protected by a fire resisting material or enclosure complying with the FRC.

The motor for the ventilating fans (extraction or make-up) shall provide nominal rating of minimum 20 % higher than the motor operating power input under nominal operating requirement. The motor windings shall be insulated to permit motor operation at design conditions for a period of 1 hour in an ambient temperature of at least 250 °C. The fan motor shall be installed outside the hot air stream where possible.

In order to prevent re-circulation of smoke, the discharge points of smoke shall be separated by not less than 5 metres in any direction from all air inlets or other openings into any buildings. The discharge of smoke into any means of escape or a fireman's staircase is strictly prohibited.

The Contractor shall note the following requirements: -

(i) The smoke shall not be discharged at the underside of any canopy or overhang; and

(ii) No discharges shall be at a height less than 3 metres measured from the surrounding horizontal surface to the bottom of the outlet and where the height is below 6 metres, the smoke shall not be discharged downwards.

(c) Ductwork and Fittings

The Contractor shall supply and install ductwork and associated fittings for smoke extraction system installation as shown on the Drawings and as required to suit the smoke extraction requirements. Unless otherwise specified, the fabrication and testing of all ductworks shall conform to DW 143 & DW 144, industrial grade, and the requirements stipulated in this General Specification. All ductwork shall be fabricated from galvanised sheet steel and aluminium sheets shall not be accepted.

The smoke extraction system ductwork shall not be provided with fire or smoke dampers and any other restrictions in the ductworks unless otherwise accepted by the FSD. Exceptions will be where only one extraction or supply system is used to serve several compartments where motorized fire and smoke dampers to the approval of the FSD may be required. Also, motorized fire and smoke dampers to the approval of the FSD shall be required at the main exhaust outlet louver and main supply intake louver. If smoke extraction system ductworks passes through compartments, all parts of the ductwork outside the served compartment shall be protected by enclosure or covered with fire resistant materials as required in the FRC, such part shall be fire resisting to BS 476-24: 1987 or to be totally enclosed by fire resistant construction to BS 476-20: 1987 having fire resistance period not less than that of the wall or floor of the served compartment or the compartment containing the ductwork whichever is higher.

Motor operated fire and smoke dampers shall comply with UL 555S: 1999 Class I, and where relevant ISO 10294 Part 1-5, and other international standards approved by the Architect and the FSD. Motor operated fire and smoke dampers shall be failsafe design. The damper shall be complete with electric motor actuator enclosed with suitable fire rated enclosure. Damper module installations shall be fully sealed by gaskets or approved materials between the module frame and the mounting frame. Apart from meeting the fire resistance requirements in the FRC, the gasket material shall be capable of withstanding exposure to an ambient temperature of at least 250 °C for not less than 1 hour without producing smoke or any toxic fumes. Damper manufacturer shall certify that the assembled dampers, including all accessories and controls, can withstand 250°C for the duration of 1 hour without distortion, buckling, damage to seals, bearings, or any deleterious effect.

(d) Electrical Installation

The essential power supply and distribution systems feeding the smoke extraction & make-up air supply system shall fully comply with the requirements of the FSD. All wiring, cables, electrical equipment, starters relays, controls etc. from the building primary and secondary sources of supply shall be suitable for continuous operation at 250 °C ambient for 1 hour minimum.

When the motor control panel are used for supplying the smoke extraction & make-up air supply systems, the motor control panel shall be of a type tested cubicle form constructed to BS EN 60439-1: 1999 from not less than 2 mm thick panel steel and all sub-distribution boards, wirings, cables etc. shall be located in a room or enclosure having a fire resistance period of not less than 2 hours and containing no other equipment.

(e) Control and Actuation

All system shall be automatically activated whenever the smoke detector and any control/sensing device designated as its actuation device is activated and shall remain in operation until manually reset with visual and audible warnings. The system shall also be activated by manual control switch and/or designated sprinkler flow switch in the same area in case the smoke detection system fails to activate the smoke extraction system before sprinkler operates. Where the smoke extraction system is installed in areas vulnerable to unwanted fire alarms, suitable special detection system to the approval of the Architect and the FSD shall be supplied and installed. Where the smoke extraction equipment are not installed by the Contractor, the Contractor shall co-ordinate, supply and install dry contacts for transmission of "fire" signal for actuating the smoke extraction systems which shall connect directly from the fire alarm control system. All outgoing wirings and accessories from these dry contacts to the motor control panel of smoke extraction system shall comply with FSD's requirement.

When in "fire" mode, no smoke extraction system connected therewith shall be controlled or under the influence of any other building services systems nor shall failure or close down of such building services systems prevent its operation. However, such building services systems may monitor the operations of smoke extraction system as required.

Each system shall be supplied and installed with a manual on/off control switch and indicator light at the fire control panel. The indicator lights to show manual on or off operation shall be supplied and installed with a red bezel and be flashing and those showing satisfactory operation of the fan(s) shall have a green bezel and be a steady light.

Unless otherwise specified, the detection system selected for the dynamic smoke extraction system shall be of early detection types. For clean areas, very early smoke detection alarm (VESDA) system or system having equivalent functions and performance as approved shall be adopted. For unclean areas and areas with high humidity, detection system shall be generally of early response type appropriate to the applications which can respond at an early stage of fire with low smoke. The system shall however be equipped with necessary facilities such as cross-zoned design (coincidence connection) to the approval of the FSD, compensation for high humidity, sensitivity drift adjustment etc. to avoid false fire alarm and unwanted fire alarm. Special detection system shall be used as necessary or specified. For cross-zoned design, an alarm with visual and audible warnings on the control panel shall be raised when one detector is activated. Smoke extraction system shall operate with the actuation of any two detectors in coincidence connection. Where required by the FSD and approved by the Architect, activation of the detectors provided solely for the smoke extraction system shall not sound the general fire alarm and shall not send the fire signal via the fire alarm direct link and the alarm transmitter.

Control switches shall be supplied and installed in the control panels and in the main fire alarm control and indicating panel/fire control centre for activating and switching off each fan of the dynamic smoke extraction system manually.

B12.5 AUTOMATIC ACTUATING DEVICES AND DAMPERS

Unless otherwise specified, automatic actuating devices controlled by fire/smoke/explosion detection system, fire alarm system and automatic facilities such as sprinkler flow switches etc. where indicated on the Drawings for protection of compartment, for closing an area for gas flooding system, for licensed areas and where required, shall be supplied and installed by the Contractor. All power, controls and wiring shall be included. The automatic actuating devices shall be of approved type and shall be suitable for the hazard class in the area protected.

Automatic actuating devices for fire shutters shall be operated by smoke detectors and complete with manual controls on both sides except for fire shutters located in car park areas and in kitchens which shall be operated by heat detectors or special approved devices with manual controls.

For the dampers installed on a door, the automatic actuating device shall be connected to an electromagnetic remote damper release unit. The electromagnetic remote damper release unit shall be suitable for mounting outdoor for remote actuation of the dampers. The actuating mechanism shall be durable and reliable. The unit shall be of fail-safe design such that the damper shall be released at no power supply. The unit shall consist of a sheathed steel wire connected to the electromagnetic remote damper release unit at one end and the fire damper locking device at the other end or a similar approved facility. The sheathed steel wire shall be anchored at strategic points such that the steel wire can move freely relative to the outer skin. A fire signal shall actuate the unit by spring return mechanism or similar that will pull the steel wire and release the damper. The design shall be such that none or only a small section of the sheathed wire is located outside the room for good appearance and the unit installed outdoor shall be mounted inside a dust and moisture proof stainless steel box recessed in the external wall. The electromagnetic remote damper release unit shall be complete with power on indication and damper reset facilities.

Fire dampers shall be provided at locations and constructed to standards as required by the FSD and Buildings Department to comply with the Buildings Regulations for compartments and openings. Where specified, fire dampers shall also be designed and constructed to comply with UL555S Class I, or equivalent approved international standard for smoke dampers, to restrict the spread of smoke. The combined fire and smoke damper shall be complete with electric motor actuator enclosed with suitable fire rated enclosure and shall be able to close completely at design air pressure and flow during fire. Apart from meeting the fire resistance requirements in the FRC, damper manufacturer shall certify that the assembled fire and smoke dampers, including all accessories and controls, can withstand 250 °C for the duration of 1 hour without distortion, buckling, damage to seals, bearings, or any deleterious effect. In addition to the fusible link, the fire and smoke dampers shall be operated by the building fire alarm system provided in the same building zone which includes manual fire alarm, flow switches in sprinkler system and detectors in the VAC control system.

An inspection door shall be provided for each damper and associated fusible link for regular inspection and for each automatic actuating devices for maintenance purpose.

When required by the FSD and approved by the Architect, activation of detectors provided solely for the automatic actuating devices shall not sound the general fire alarm and shall not send the fire signal via the fire alarm direct link and alarm transmitter. However, an alarm with visual and audible warnings shall be provided on the control panels. The detectors for the automatic actuating devices shall be wired in coincidence connection when two or more detectors are provided.

B12.6 SPECIAL FIRE SERVICE INSTALLATION

Special fire service installation shall include, but not limited to, fixed and mobile foam system, dry chemical system, foam water system, water mist system, explosion protection system, water spray system, dust detection system, dry powder system, wet chemical system, restaurant fire suppression system, gas detection system, life safety system, industrial fire protection system for high hazard areas and other fire service systems not covered in other parts of this General Specification.

Special fire service installation shall be supplied and installed where specified and as required. The Contractor shall design, supply and install the special fire service installation to comply with the statutory requirements and with careful consideration on the factors of performance, maintenance, reliability and resilience. Unless otherwise approved by the Architect for minor design, the Contractor shall employ a qualified professional engineer to be responsible and to carry out the design for the special fire service installation. The engineer employed shall be a Registered Professional Engineer in Hong Kong under CAP 409 in building services discipline (or equivalent approved professional qualification) specialised and experienced in fire service installation design.

The Contractor shall submit the detailed design of the special fire service installation including drawings, calculation, equipment catalogues and other information for acceptance by the FSD and approval of the Architect. For proprietary system, the design and design calculation shall be supported by manufacturer's data and according to manufacturer's design manual. The Contractor shall obtain acceptance of the FSD and the approval of the Architect on the design before ordering of equipment and carrying out installation work on Site.

Where pre-engineered system is used, the Contractor shall provide the system manufacturer's design manual and calculation. Where engineered system is used, the Contractor shall submit full mathematical calculation or computer modelling with manufacturer's design manual. When proprietary computer programme is required to complete the design and the computer programme does not show all calculation steps, the Contractor shall produce evidence that the result generated by the computer programme is in accordance with the relevant international standards and accepted by the FSD.

For equipment model that has not been accepted by the FSD before, the Contractor shall obtain the endorsement of the FSD and the Architect before ordering. The installation shall follow manufacturer's recommendation and the best practices in appropriate standards such as NFPA codes, BS standards etc. to the acceptance of the FSD and the approval of the Architect.

For special equipment that has not been accepted by the FSD before, the Contractor shall employ Registered Professional Engineer in Hong Kong under CAP 409 in approved discipline to certify the performance and functioning of the special equipment and obtain the endorsement of the FSD and the Architect.

Where specified for better life safety protection, the Contractor shall provide emergency telecommunication system within building such as fixed intercom unit at fireman lift lobby of each floor with main/repeater panels at fire control centre and building security/guard room to facilitate rescue operation and reporting during emergency.

B12.7 RELATED FIRE SERVICE INSTALLATIONS AND PROVISIONS

RFSI and RFSP shall comply with FSDCoP, FSD Requirements and Circular Letters, MoE, FRC, MoA, and relevant statutory requirements.

Where there are RFSI in the same building to be inspected by the FSD, the Contractor shall co-ordinate with others, inspect, check and witness the final functional and performance tests on all RFSI by others to identify any non-compliance with the requirements in FSDCoP, FSD Requirements and Circular Letters, MoE, FRC, MoA and FS_TC. Any works found not complying with the fire service requirements of the FSD shall be rectified by the Contractor when they are included in the Works or be reported to the Architect when such works are carried out by others before arranging inspection with the FSD. Upon witnessing the satisfactory completion of all final tests and inspections after rectification of non-conformities related to fire service, the Contractor shall then arrange inspection by the FSD on all fire service installations in the building including RFSI by others.

Where there are RFSP in the same building to be inspected by the FSD, the Contractor shall co-ordinate with others, obtain and check the information and certification from relevant parties on all RFSP by others to confirm their completion and readiness for inspection by the FSD.

The Contractor shall co-ordinate and check that all RFSI and RFSP by others to be inspected by the FSD are tested, rectified where necessary and certified by relevant parties before arranging the inspection with the FSD.

The Contractor shall collect information from relevant parties and include the RFSI in the submissions such as Form 314 to the FSD. The Contractor shall also submit the drawings with calculation on the RFSP where necessary to the FSD for approval.

The Contractor shall employ a commissioning engineer in charge approved by the Architect to co-ordinate and oversee the completion of all works in a building or project required to be inspected by the FSD irrespective of whether the installation of such works are included in the Works or by others. All RFSI and RFSP by others shall be included. The Contractor shall in particular pay attention to the interfacing works and signal transmission to different installations as well as the communication link with outside.

Where certificates and licences are required by the FSD for completion of the fire service inspections, the Contractor shall co-ordinate with relevant parties, check and confirm that all the licences and certificates are obtained before arranging the inspection with FSD. The licences and certificates may include, but not limited to, licences for emergency generator rooms, fuel tank rooms and dangerous goods stores, certificates for gas cylinders, certificates for radioactive substances, and other statutory licences as required.

In licensed premises, the Contractor shall use approved equipment of appropriate types such as explosive proof, flameproof, weatherproof, corrosive resistance, spark-proof, intrinsically safe etc. to suit the applications. Where mechanical ventilation systems in licensed premises are included in the Works, all necessary fire dampers and smoke dampers shall be provided. The ventilation system shall also be interlinked with the gas detection system and other detection systems, when they are supplied and installed in the licensed premises as required by the FSD.

SECTION B13

MISCELLANEOUS

B13.1 LABELS AND NOTICES

Labels and notices shall be supplied and installed for all pumps, valves, switches, gauges, indicators, cables, internal wiring terminals and all other equipment to facilitate operation and proper maintenance of the fire service installation. All labels shall make cross reference to the operation and maintenance manuals and as-built drawings

Labels and notices required by statutory requirements shall be inscribed accordingly whereas other labels shall indicate name and purpose of the equipment together with ratings and commissioned set values where applicable.

Labels for equipment identifications shall be made of red plastic material or multi-layer Formica with white lettering or as approved. Lettering shall be engraved on the plastic material or Formica. All wording shall be in both Chinese and English. All labels shall be of adequate size as to give clearance between lettering and fixings to ensure an aesthetic arrangement on completion.

Notices for safety warning and instructions shall be constructed of heavy gauge aluminium sheets painted with symbols or wording as appropriate.

Notice for instruction for operation and use of the equipment shall be provided as appropriate and necessary. Instructions for use shall be provided to all equipment for use by the general public and for operation by the operating staff.

Labels and notices shall be fixed by screws. Where drilling and tapping is impracticable, approved adhesive may be used subject to prior approval by the Architect. For pipelines or valves, where applicable, labels shall be fixed by means of a key ring attached to the upper corner of the pipe mounting bracket or the hand wheel of valves. The labels shall be suspended from brass or stainless steel chain loops over the relevant pipe.

All major fire service equipment and components such as pumps and motors, flow switches, alarm valves, expansion joints, pipes and fittings etc. shall have factory applied permanent nameplates indicating, where relevant: -

(a) Name of Manufacturer;

(b) Model;

(c) Serial Number;

(d) Design Flow Rate, Pressure etc.;

(e) Rated Duty;

(f) Operating Voltage, Phase, Ampere, and Frequency;

(g) Full Load Current and Power;

(h) Starting Method and Current;

(i) Power Factor;

(j) Date of Manufacture;

(k) IEC, British Standards or other Authorities' markings to indicate their compliance and grades of application; and

(l) Any other necessary data to conform to specified requirements and to indicate the equipment performance.

Instructions for oiling and/or greasing of all fans, motors etc. shall be attached to the relevant greasing or oiling points.

Where the equipment has an operating life less than or equal to 10 years, the expiry date or the 'end of service life' date has to be stated on the label attached to the equipment. Labels of approved types shall be supplied and installed for fire extinguishers, fixed sprayer units, batteries, detectors and gas extinguishing system showing the expiry date of design operating life. The label shall have a serial number of the equipment and the serial number shall be recorded on the as-built drawings.

Labels or approved identification shall be supplied and installed for the emergency luminaries, which are of the same appearance as the non-emergency luminaries, for quick identification in routine inspection.

All isolators and protective devices that can isolate the supply from the fire alarm system shall be properly labelled to the approval of the FSD.

Where specified, the Contractor shall fix barcode labels to the equipment, and shall supply portable handset equipment for scanning and reading the barcodes and storing the data for transfer/download to a personal computer. It shall be complete with LCD display, storage batteries and software for categorising the data. Details shall be submitted to the Architect for approval. The portable handset equipment shall be stored in a separate wall mounted cabinet with locks provided by the Contractor in the pump room or in the control room as approved by the Architect. Where specified, the Contractor shall supply and install the software for producing facility management reports and inspection reports from the data downloaded by the portable handset equipment. Details shall be submitted for approval.

B13.2 DANGER NOTICES

Danger notices worded : DANGER-PLANT ON AUTOMATIC START (危險-機器隨時開動) in English and Chinese shall be supplied and installed adjacent to all automatically controlled motor-driven and engine-driven pumps.

Notices, instructions of use complying with the requirements of Labour Department and Occupational Safety and Health Ordinance, Chapter 509, shall be supplied and installed.

B13.3 PAINTING, FINISHING, PROTECTION AND IDENTIFICATION

Painting shall follow General Specification for Building unless otherwise specified.

Paint all surfaces including cable trunking/conduit, panel, box, enclosure, cladding, pipework, equipment, fitting etc. except otherwise specified.

Self-finished surfaces like stainless steel, anodised aluminium, chrome plated, bronze, plastic etc. are not required to be painted.

Galvanised pipework concealed in false ceiling or galvanised duct not normally accessible and/or seen need not be painted unless otherwise specified, but appropriate colour code indication shall be applied.

Equipment with factory applied paints or epoxy coatings need not be painted.

Painting and coatings for the purpose of protecting the materials from corrosion including those inside concealed spaces shall be required.

All surfaces, unless otherwise specified, shall be finished in first class paint work. All metallic surfaces shall be wire-brushed and cleaned to make it free from rust, scale, dirt and grease prior to painting. All work shall be carried out by qualified tradesmen. Water based paints with reduced volatile and preservative content or paints with reduced solvent content formulated for minimal volatile organic compound emissions complying with reputable international standards shall be used in occupied areas and renovated areas without good natural ventilation. In addition, all paints shall contain no mercury, lead, hexavalent chromium or cadmium compounds. All painting works shall be completed and left in ventilated environment for at least 1 week, or the curing period recommended by the paint manufacturer whichever is longer, before occupation or handover of the renovated area to minimize volatile organic compound exposure. All surfaces shall be painted and finished as specified in the Particular Specification to meet and match the aesthetic architectural design as required.

Painting shall be of approved type and shall be generally to CP 231 and as described below: -

(a) Do not carry out painting work in wet, humid or foggy weather or on surface that is not thoroughly dry or if there is excessive dust in the air.

(b) Ensure that all holes, cracks and other defects in surface have been made good prior to painting.

(c) Ensure the surface is thoroughly clean and dry prior to painting. Loose material shall be removed by dry brushing with stiff broom or brush.

(d) Keep surface clean and free from dust during coating and drying.

(e) Protection freshly applied surface coating from damage.

Primer shall be applied to metal surface before the application of under and finishing coats of paint. Primer for non-galvanised metal surface shall be metallic zinc-rich primer to BS 4652: 1995, Type 2, and for galvanised surface shall be calcium plumbate primer or approved etch primer. Bare copper tubing shall be polished bright and coated with approved heat resisting clear synthetic varnish. All surfaces shall receive one primer coat, one under coat and 2 finishing coats.

The primer, under coat and finishing coat of paint shall be from the same manufacturer. The painting procedure shall be strictly in accordance with the manufacturer's instruction.

For anti-corrosion paint and primer, the correct type of thinner/activator shall be used and the mixing method shall follow the manufacturer's instructions.

The volatile organic compound (VOC) content, in grams per litre, of all paint applied on surfaces of fire service installation and any installations/equipment inside semi-enclosed/ enclosed areas of the building shall not exceed : -

Type of Internal Paint		Type of External Paint	
Water-based Paint :	50g/litre	Water-based Paint :	80g/litre
Solvent-based Paint :	400g/litre	Solvent-based Paint :	400g/litre

The testing method of the VOC content of paint shall be determined by the US EPA Method 24.

Colour of the finishing coats shall be to the approval of the Architect. Pipes and pipelines shall be complete with the identification of colour code indicators when the colour of the finishing coat is not in accordance with ISO 3864-1: 2002.

The street hydrant body shall be painted red if it is connected to fresh water supply and painted yellow if it is connected to salt water supply. If the street hydrant is removed from service, the blank cap shall be painted blue.

Copper pipes and fittings shall be polished bright by sanding, wiped with mineral spirits and coated with an approved heat resisting clear synthetic varnish.

Where normal painting is not practicable, all possible measures to prevent corrosion to the plant shall be applied such as special protective coverings, special anti-corrosive paints etc. as recommended by the supplier or specified in the Particular Specification. For protection against system internal corrosion, appropriate chemical treatment, provision of sacrificial anodes and bonding to eliminate electrolytic action shall also be applied wherever applicable.

For temporary protection, all stainless steel parts shall be covered with PVC wrapper of tape until handover. All ferrous parts shall be painted or greased (whichever is most suitable). All bright parts (chrome plates, polished stainless steel or aluminium etc.) which are liable to deterioration shall be covered with tallow or a suitable protective coating during the progress of work. Upon completion of work, the protective coating shall be removed and the parts polished as appropriate. Any damage to the primer or protective coatings shall be made good. When it is necessary to remove, or partly remove the protection for installation or making connections, the Contractor shall ensure that the standard of protection provided originally is re-applied at the earliest possible time. All plants, pipes valves, and fittings shall be, as far as possible, thoroughly cleaned and cleared of rust and other foreign matters both before erection and before subjection to pressure tests. For temperature and/or humidity sensitive electrical or electronic control panels and equipment, the Contractor shall where necessary protect them against high humidity and/or temperature by operating portable or temporary dehumidifiers and/or air conditioners in the enclosures containing these equipment. In order to protect the equipment against dust infiltration, the Contractor shall store them in a dust free room or enclose them in heavy duty PVC sheets or bags. Where necessary, filters shall be provided in the temporary air conditioning systems.

B13.4 SPARES AND TOOLS

For plant and/or equipment included in the Contract, the Contractor shall provide the types of spare parts generally wherever these are appropriate to the plant and/or equipment involved plus any additional items for the particular plant and/or equipment. Unless specified in detail, the criteria by which the Contractor shall judge the need for spare parts to be included shall be any part or component of the plant or equipment that is subject to frictional wear, vibration or temperature fatigue, rupture to safety (or otherwise), corrosion, erosion, decay, limited operating life, unacceptable deposits and/or saturation, normal fair wear and tear and is likely to fail or reach an unacceptably low performance level.

The Contractor shall provide sets of spare parts and special tools including spare sprinkler heads, detectors, replacement break glass plates, indicator lamps, special keys, fuses, parts for the gas extinguishing system after discharge etc. as required for all the following: -

(a) Required by the statutory rules and the FSD;
(b) Required by Specifications in Section A2 and in Clause B3.12;
(c) Required for one year operation and maintenance after expiry of the Maintenance Period; (All spares and tools for use and consumption within the Maintenance Period shall be provided by the Contractor separately)

(d) Required by the codes and standards adopted in this General Specification and other requirements in this General Specification at the time of completion of the Works and before commencement of the Maintenance Period.

The Contractor shall supply and install locked cabinet or cabinets in the plant room(s) and/or control room(s) for housing the spares and tools. Such sets of spare parts and special tools shall be submitted to the Architect for approval within 4 months after commencement of the Contract, or in such period as has been agreed by the Architect in writing.

The Contractor shall also supply all the spare parts and special tools required for the whole Maintenance Period for operation and maintenance of the plant and installation. The spare parts and special tools shall be in addition to the requirements in the second paragraph of this Clause B13.4. At the end of the Maintenance Period, the Contractor shall ensure that the spare parts and special tools required in the second paragraph of this clause are provided and stored in the cabinet. The Contractor shall replenish and supply at his own cost spare parts that may have been used during the Maintenance Period.

In addition, the Contractor shall include in the operation and maintenance manual a complete manufacturer's recommended list of all the replaceable parts, spares and special tools with model number, part number and quantity which are likely to prove necessary to service the plant and/or equipment. The list shall include diagrams or catalogue details of the parts concerned and with bona fide manufacturer's published price lists. Apart from this, the Contractor shall also include in the manual an undertaking stating that `all the essential components/parts of all the installed systems for operating the systems at an acceptable performance level can be delivered to Site for replacement in 7 calendar days upon order.

The Contractor shall submit information on the design operating life for equipment such as batteries, detectors, fire extinguishers, gas extinguishing system etc. that are required to be replaced some years later.

The Contractor shall provide minimum three keys for each key operating facilities, locks and switches unless otherwise specified.

B13.5 PROVISION FOR WATER METER

Metering of water supplies to fire service installation is not required. Provision shall, however, be made for the possible future connection of the Water Supplies Department meter at each point of connection to the main, immediately downstream of the main stop valve. The position of this future meter shall be shown on the installation drawings. The Contractor shall co-ordinate with the Building Contractor to obtain the information where necessary.

B13.6 NOISE AND VIBRATION

The Contractor shall take all necessary steps to prevent the transmission of any objectionable noise and vibration which affects the occupied areas of the building. Measures shall also be provided to meet with requirements in Occupational Safety and Health Ordinance, Cap 509.

Pumps and motors shall be balanced and aligned such that the measured vibration velocity at all three axis shall not exceed 1.8 mm/s rms in the range of 10 to 1000 Hz as defined in BS 4675-2: 1978, ISO 2954:1975 and ISO 10814:1996.

Motor driven pump set shall be mounted upon a common base plate supported by approved spring-type isolation mountings on concrete plinth.

Flexible connectors shall be installed at pump connections to take up vibration. Unless otherwise specified, flexible connector of single sphere or double sphere type made from rubber, EPDM and similar materials shall not be used. Construction of flexible connectors shall be as specified in Clause B1.10 for expansion joint using stainless steel. Flexible connector shall be used to absorb the vibration and shall not be used to take care of the misalignment during installation. All pumps and pipes shall be properly aligned on completion.

Pumps shall be of low noise rating especially for the jockey pump set and other equipment requiring frequent operation. Acoustic treatment shall be provided as necessary and approved by the Architect.

Acoustic treatment shall be provided to the emergency generator installation and other fire service installations and equipment to comply with statutory requirements on noise and vibration.

B13.7 EQUIPMENT BASES

All bases and supports for plant and equipment shall be supplied and installed by the Contractor, except concrete plinths and blocks, which will be provided by the Building Contractor unless otherwise specified but shall be designed by the Contractor to suit the actual equipment.

Plinths and blocks shall be designed to project approximately 100 mm above the finished floor level.

B13.8 SAFETY FACILITIES

Facilities for operational and maintenance safety shall be supplied and installed to comply with the Occupational Safety and Health Ordinance and with the requirements of Labour Department. All moving parts shall be appropriately covered and emergency stops shall be supplied and installed where necessary. Adequate spaces and facilities shall be allowed for maintenance and access.

B13.9 SCHEMATIC DIAGRAM AND KEY LAYOUT DRAWINGS

Schematic diagrams and where relevant key layout drawings shall be provided to all major plant rooms and fire service control rooms. The diagrams and drawings shall be mounted in glazed frames and installed in appropriate locations in the rooms.

PART C – PERFORMANCE BASED FIRE ENGINEERING

SECTION C1

PERFORMANCE BASED FIRE ENGINEERING

C1.1 GENERAL

Performance based fire engineering (PBFE) approach shall be adopted where specified for the study, assessment, design, analysis, problem solving, selection and/or holistic evaluation of the whole fire service and building design, fire service equipment/installation, building material/construction, life safety protection, property protection, fire fighting need, associated fire risk and hazard, and performance of systems in fire.

Where PBFE approach is required, the Contractor shall employ adequate and not less than one competent and qualified professional engineer(s) specialised and experienced in the performance based fire engineering and approved by the Architect to carry out the works for PBFE and to be responsible for the interfacing of PBFE with works by others. Details including names, curriculum vitae, qualifications and professional experience of the professional engineer(s) specialising in fire engineering shall be submitted for approval. The professional engineer(s) responsible for the PBFE shall have qualifications and professional experience at least equivalent to a corresponding Registered Professional Engineer in Hong Kong under CAP 409 in approved disciplines (or other equivalent approved professional qualifications), have acceptable professional experience in fire service installation design and studies, have recognised and approved academic qualifications, training and post-qualification professional experience in performance based fire engineering, and have adequate knowledge of Buildings Regulations in Hong Kong, all to the satisfaction and approval of the Architect.

C1.2 STANDARDS AND GUIDES

The performance based fire engineering approach, study, analysis, assessment, application or similar works shall follow internationally recognised fire engineering standards, codes and guides acceptable to the FSD and Building Authority, and approved by the Architect. Some known standards, codes and guides shall include, but not limited to, the following:

(a) Society of Fire Protection Engineers - Engineering Guide to Performance Based Fire Protection, and The Society of Fire Protection Engineers Code Official Guide to Performance Based Design Review and Analysis of Building

(b) BS 7974: 2001 and PD 7974 Part 0 to Part 7 for Application of Fire Safety Engineering Principles to the Design of Buildings;

(c) Chartered Institution of Building Services Engineers - Guide E on Fire Engineering;

(d) Recommendations of the International Organisation for Standardisation Sub-Committee - ISO/TC92/SC4, BS ISO/TR 13387: 1999 Part 1 to Part 8 and associated standards;

(e) Performance Based Option in NFPA 101: 2006 and NFPA 101A: 2007;

(f) Performance Based Building Codes/Fire Codes in U.K./Sweden/ Australia/New Zealand/Japan/other developed countries.

The Contractor shall select the most appropriate standards, codes and methodologies for the PBFE approach and shall obtain the agreement of the FSD and Building Authority and the approval of the Architect.

The Contractor shall follow Practice Notes for Authorised Persons and Registered Structural Engineers PNAP 204 – Guide to Fire Engineering Approach published by the Buildings Department.

The Contractor shall also comply with the latest codes, guides, manuals and other requirements on PBFE issued by the FSD and Building Authority.

C1.3 COMPUTER SOFTWARE AND TOOLS

Where the PBFE approach requires the use of computer software and/or tools for the modelling, analysis, simulation and/or calculation, the cost for the use of all such facilities, computer hardware, software and computing works shall deem to be included. Hard and electronic copy of the computed result and output shall be submitted. The Contractor shall allow the cost for demonstration to the Architect the output including the modelled result locally on computers provided by the Contractor.

The Contractor shall provide accredited/validated certificate(s), appropriate evidence and/or substantiation showing the acceptance of the computer software and tools by internationally recognised bodies for similar PBFE analysis. The Contractor shall provide details of the principles, formulae, assumptions, limitations, data, and calculation adopted in these computer software and tools when required by the Architect. All calculation and computed results shall be checked and endorsed by the competent and experienced professional engineer(s) employed by the Contractor for the PBFE in Clause C1.1.

C1.4 TESTS

Where the completion of PBFE require site tests, fire/smoke tests, laboratory tests and/or full scale tests for completion of the studies and evaluation, all such tests including fire tests, mock-up tests, simulation tests, smoke tests, field tests and trial tests, on site and/or off-site, shall deem to be included in the Works. All laboratory fire/smoke tests shall be carried out by approved independent laboratories/testing bodies experienced and widely recognised internationally for carrying out tests for fire studies and fire materials. Details shall be submitted for approval.

C1.5 INDEPENDENT CHECKING

For PBFE approach used for fire service/fire safety/building design, selection of fire service system/equipment, evaluation of alternate solutions for compliance with statutory requirements, evaluation of new fire service system, risk assessment of major modification works, and assessment of building/structural fire protection and life safety provisions such as fire compartments and occupant evacuation, the Contractor shall employ an independent qualified and experienced professional checking engineer specialised in the PBFE to the approval of the Architect to check, validate and audit on all the design, assessments, analysis, calculations, computer modelling, submissions and all works on the PBFE by the Contractor and to report all the findings independently to the Architect. The professional qualification and experience of the independent checking engineer for the PBFE shall be at least equal to or better than that of the professional engineer employed under Clause C1.1 for the PBFE and shall be approved by the Architect.

C1.6 PROGRAMME AND SUBMISSION

The Contractor shall provide a detailed programme for the PBFE including the time allowed for consultation with various authorities and parties. Since the results of fire engineering will affect the provisions of fire service installation and building design, the Contractor shall allow for carrying out the fire engineering studies and applications in the early stage of the Contract before commencing the installation works.

The Contractor shall collect and provide all the data, statistics and information used for the studies and evaluation in fire engineering. The Contractor shall obtain the comments and approvals from the FSD, Building Authority, and relevant government departments and authorities on the assumptions used, statistical and fire data, approaches, methodologies and the results of the PBFE. The Contractor shall allow the cost for making submissions, re-submissions and discussion with relevant parties and authorities before finalising the studies and evaluation.

The Contractor shall submit the results and reports of the PBFE in a format acceptable to the Architect covering details of the objectives, functional and performance statement, methodologies, principles, assumptions, limitations, statistics, data, formulae, calculation, standards adopted, risk analysis, computer modelling, figures, diagrams, models, test results, evaluation, solutions, recommendations and other relevant information. The Contractor shall submit and re-submit as necessary to the Architect both hard and electronic copy (stored in CD-ROMs) of the documents on the results/reports of the PBFE and at least 3 copies each or as specified are required. The electronic copy shall be of file format as specified or approved by the Architect. Before submission of the final results of the PBFE to the Architect for approval, the Contractor shall submit and obtain the approval of relevant authorities such as the FSD and Building Authority on all the results, solutions and recommendations. The professional engineer specialised in fire engineering employed under Clause C1.1 shall endorse all the documents before making the submission. The documents shall also be checked by the independent checking party when provided.

After the approval by relevant parties and authorities, the Contractor shall include the results and reports of the PBFE, with all the approved amendments made during the installation, in the operation and maintenance manuals.

Before carrying out the detailed PBFE study, the Contractor shall submit preliminary report to seek comments from the Architect, the FSD and the Building Authority on the approach and scope in the study. The preliminary report shall cover but not limited to the following: -

(a) Objectives;

(b) Project description and identification of areas of fire risk for the study;

(c) Assumptions;

(d) Acceptance criteria and risk level;

(e) Hazard identifications;

(f) Fire scenarios;

(g) Functional, performance and code requirements;

(h) Alternate solution/trial concept design to be investigated;

(i) Evaluation method and level; and

(j) Tools/tests/software to be used.

The final reports of PBFE shall include but not limited to the following: -

(a) Objectives, project description, code requirements, assumptions, functional statements, performance statements, documentary evidence, deviations from codes, alternate solutions, recommendation and all other sections as required in relevant standards, codes and guides;

(b) Qualitative assessment and/or quantitative assessment (deterministic and probabilistic) as appropriate following relevant standards, procedures and guides;

(c) Risk assessment where applicable, except for simple cases where comparative method, expert judgement and verification method are acceptable;

(d) Fire engineering solution;

(e) Sensitivity analysis of the assumptions used and data;

(f) Assessment on the safety factors, redundancy, limitation, and contingency provided in the solution in comparison with the prescriptive codes;

(g) Recommendation and conclusion; and

(h) Recommended precautionary measures and boundary conditions that should be followed by the users/operators in future. This shall include the submission of a fire safety management plan for ensuring that the fire safety measures essential to achieve the accepted fire engineering performance level as alternative to the prescriptive design be implemented and up-kept.

C1.7 ACCEPTANCE CRITERIA

PBFE aims to improve and strengthen the fire safety in the buildings in particular life safety of the occupants. The analysis and evaluation shall target to improve the building design and fire service provisions to satisfy the fire safety requirements, building regulations, and the concern on the fire risk and fire hazards particularly for those parts of the design that may not be adequately covered in the prescriptive fire codes and building codes.

The Contractor shall not use PBFE as the tool primarily to reduce the building and/or fire service provisions in the prescriptive fire codes, building codes, standards and regulations because factors of redundancy, safety margin, contingency and spare capacity may often have been built into the provisions of such codes, standards and regulations to cater for the variance in performance and unforeseen circumstances. Any reduction of the safety margin and allowance, though may still comply with the minimum standard, will reduce the overall fire safety standard of the building and will not be accepted. The Contractor shall allow adequate safety margin, redundancy and allowance in the performance based fire engineering studies and applications to maintain equivalent or better fire safety standards in comparison to the prescriptive codes and other similar buildings in the territory.

The Contractor shall not use PBFE as the tool solely to delete any requirement in the prescriptive fire/building codes and regulations unless alternate and/or additional fire safety measures to the approval of the Architect, the FSD and Building Authority shall be provided to strengthen or maintain the fire safety. Use of the PBFE to prove the building is still fire safe on deleting some requirements in the prescriptive fire codes/building codes and regulations and without corresponding alternate/additional fire safety measures added will not be approved.

The Contractor shall use a holistic approach in carrying out the PBFE study.

The following are the minimum criteria to be considered in the assessment: -

(a) Occupant's/public life safety;

(b) Fire fighter's life safety;

(c) Fire spread to adjacent compartments and buildings;

(d) Property loss and structural fire protection;

(e) Loss of business operation/opportunities as appropriate;

(f) Damage to heritage buildings where applicable;

(g) Environmental and community impact as appropriate; and

(h) Cost effectiveness where appropriate and not at the sacrifice of fire safety.

C1.8 RESULT OF THE STUDY

Where the approved result of the PBFE indicates or requires addition and/or modification of the design, materials, equipment and/or installation details of fire service installation or building design to comply with the requirements, all such additional works and/or modifications shall be included in the Works at no additional cost and as approved by the Architect unless otherwise specified. Where the approved result of PBFE indicate deletion of some parts of fire service systems or fire resistant materials in whole in a zone or in any room, the deletion of such systems or materials shall not be carried out without the prior approval of the Architect and the cost saving for the deletion of such part of fire service installation shall be assessed and the Contract Sum will be adjusted in accordance with the Contract as appropriate.

C1.9 LIFE SAFETY PROTECTION

A holistic approach shall be adopted for the PBFE assessment. The PBFE assessment shall in particular put emphasis on life safety protection and human safety including the safety of the persons with disability, the elderly, the pregnant women and the children complying with current international standards. All possible fire and smoke scenarios shall be covered in the study. Fire may be initiated by various incidents including fire accidents, failure of electrical and mechanical equipment, sabotage, natural disasters, and arsons. They shall all be addressed as appropriate and approved. Additional facilities such as emergency communication system, smoke control dampers and equipment etc. that can improve life safety protection shall be considered and utilised.

Smoke is one of the major hazards in fire accident. The assessment shall elaborate the details of mitigating the risk of smoke for life safety protection of building occupants. The approved measures for mitigating the fire and smoke risk for life safety protection in the PBFE assessment may be above the minimum standards under the statutory requirements. Unless otherwise specified, all additional measures for life safety protection approved under the PBFE assessment, study or similar works shall be included in the Works when PBFE assessment forms part of the scope of the Works.

PART D – INSPECTION, TESTING AND COMMISSIONING

SECTION D1

INSPECTION, COMMISSIONING AND ACCEPTANCE TEST

D1.1 GENERAL

All fire service installation shall be suitably commissioned and tested by the Contractor to the satisfaction and approval of the Fire Services Department and the Architect. The Contractor shall employ qualified and experienced commissioning engineers approved by the Architect to carry out the testing and commissioning of fire service installation.

D1.1.1 STANDARD AND REQUIREMENTS

The Contractor shall follow relevant approved standards, procedures, guidelines in the testing and commissioning works. They shall include but not limited to :

(a) Statutory Obligations and other requirements, Specifications and Standards specified in Part A;

(b) Testing and Commissioning Procedure for Fire Service Installation in Government Buildings Hong Kong Special Administrative Region and Testing and Commissioning Procedure for Electrical Installation in Government Buildings Hong Kong Special Administrative Region;

(c) Detailed inspection, testing and commissioning methods and procedures approved by the Architect;

(d) Manufacturers' recommendation and specifications;

(e) Test requirements under various standards including British Standards, European Standards, ISO Standards, IEC Standards, National Fire Codes by NFPA, UL/FM's publications and other international standards on fire protection.

D1.1.2 COMMISSIONING ENGINEER

The Contractor shall appoint not less than one competent and experienced commissioning engineer (referred as the Commissioning Engineer in Charge (CEIC)), responsible for the overall planning, organizing, coordinating, supervising and monitoring of the testing and commissioning works and also certifying all results and reports from the testing and commissioning works. The Contractor shall submit, at the commencement of the Works, information detailing the qualification and experience of the CEIC and other testing and commissioning engineers for the Architect's approval.

The CEIC shall have minimum 3 years on-site experience in similar type and scale of testing and commissioning works unless otherwise approved by the Architect for minor installation. The CEIC shall have at least 3 past project references with the fire service systems tested and commissioned by the CEIC personally. The CEIC shall also possess the relevant qualifications and experience required by the FSD for carrying out the corresponding testing and commissioning works for special systems when included in the Works.

The CEIC shall also oversee, co-ordinate and monitor the completion of all RFSI and RFSP stated in Clause B12.7. The CEIC shall be responsible for the submission of detailed testing and commissioning procedures and methodologies, co-ordinating the programme and sequence of testing and commissioning works, arranging for the testing and re-testing of the installations, supervising the testing and commissioning works, and certifying the results of all the tests. The CEIC shall personally lead and co-ordinate the final mock-up test and the statutory inspections with the FSD.

D1.1.3 MASTER PROGRAMME OF TESTING AND COMMISSIONING WORKS

The Contractor shall submit a programme for testing and commissioning works at the commencement of the contract, within the first 3 months after the date of commencement of the Works. The programme shall indicate the tentative dates of all tests and commissioning works that will be carried out throughout the whole contract and all necessary submissions and approval relating to testing and commissioning. The Contractor shall ensure that the testing and commissioning programme matches the master programme for construction and that all testing and commissioning works are complete before the completion date of the Works.

A detailed checklist of all the equipment and installation of the Works to be commissioned and tested shall be submitted at the same time. The checklist will be used for progress monitoring and shall be updated from time to time as the Works progress towards completion.

The testing and commissioning programme submitted by the Contractor shall detail the type of testing and commissioning works required, the breakdown of the programme into floor-by-floor and/or area-by-area basis, the tests that are required during construction and before completion of the Works, the period of each test with float time allowed, the milestone dates for the connection of fire alarm direct link, the dates of final mock-up test and the statutory/licensing inspections, the programme for the completion of builder's works such as pump room, control room, water supply, electrical supply etc. Critical path programme shall be submitted. The Contractor shall plan the programme so as to minimise the overlapping of different tests arranged simultaneously in different locations of the Site.

D1.1.4 INSPECTION, TESTING AND COMMISSIONING METHODS AND PROCEDURES

The Contractor shall submit detailed inspection, testing and commissioning methods and procedures together with report formats for reporting inspection, testing and commissioning results for the Architect's approval within 4 months after commencement of the Works, or at least 4 months before commencement of the tests required, whichever is earlier.

For minor works under works order of minor works contract with short construction period, the submission of detailed inspection, testing and commissioning methods and procedures together with report formats shall be made at least 4 weeks before the commencement of any testing and commissioning works.

Submission for works to be tested and commissioned during the construction period shall be made in good times matching with the construction programme for approval. For tests that have to be done satisfactorily before subsequent construction work, such tests shall be completed to the approval of the Architect before new construction work is to be carried out.

The Contractor shall submit detailed inspection, testing and commissioning methods and procedures following the format in FS_TC and EE_TC, adding additional pages and details in accordance with the manufacturers' recommendation and relevant standards, and adding testing and commissioning procedures for systems and equipment not covered in FS_TC and EE_TC. The detailed procedures shall be separated into two major parts covering the following: -

(a) Testing that is required to be carried out during the construction period; and

(b) Testing and commissioning that are required for certifying the completion of the Works before the commencement of the Maintenance Period.

D1.1.5 EQUIPMENT, APPARATUS AND TOOLS

The Contractor shall provide, at no cost to the Employer, all necessary equipment, apparatus, tools and materials for carrying out the testing and commissioning works.

D1.1.6 LABOUR AND MATERIALS

The Contractor shall be responsible for provision of all labour and both consumable and non-consumable materials for carrying out testing and commissioning works at their expenses. Electricity supply, water, diesel, chemicals, LP gas, town gas, fire extinguishing gases/media, lubricants, and other fuel oil for engine-driven pumps and generators for carrying out testing and commissioning works shall be arranged and provided by the Contractor at no cost to the Employer. Where specified, Building Contractor may supply electricity and water. The Contractor shall provide sufficient fire extinguishing gases/media for the discharge tests of the gaseous extinguishing system complying with the FSD requirements.

The Contractor shall despatch competent and experienced commissioning engineers and technicians to carry out testing and commissioning.

The Contractor shall replenish all fire extinguishing media, gases and other materials expended or used during the test and ensure that the entire installation including portable hand-operated approved appliances is in "as new" and functional condition at the conclusion of the tests.

The Contractor shall clean the detectors after the test. Before the fire service installation is put into operation, the Contractor shall protect the detectors from dust and dirt by temporary protection or PVC wrapper or similar.

The Contractor shall properly drain the water and exhaust the gases during and after the test as required. The Contractor shall provide and adopt measures to avoid damage to the building, installations, decorations and fixtures during the tests.

D1.1.7 SUPPLY OF INSPECTION, MEASURING AND TESTING EQUIPMENT

The Contractor shall supply the calibrated inspection, measuring and testing equipment and instrument for testing and commissioning works in accordance with the requirements as specified in the Particular Specification. Certified true copy of calibration certificates shall be submitted.

D1.1.8 READINESS FOR COMMISSIONING AND TESTING

The Contractor shall check the completion of the works to be tested or commissioned, the associated builder's works and the associated building services installations to ensure that testing and commissioning can be proceeded in a safe and satisfactory manner without obstruction.

D1.1.9 TYPE-TEST CERTIFICATE

Type-test for equipment shall be carried out at the manufacturers' works or elsewhere appropriate in order to demonstrate their compliance with the Regulation or requirements. Where 'type-test' certificate is required, "type-test" certificates together with the corresponding drawings, sketches, reports and any other necessary documents shall be submitted to the Architect for approval before delivery of the equipment.

D1.1.10 NOTICE OF INSPECTION, TESTING AND COMMISSIONING WORKS

The Contractor is required to provide advanced notice for inspection, testing and commissioning works as follows :

(a) Off-site Inspection and Testing

An advanced notice of at least one week before commencement of the inspection or test shall be provided.

(b) On-site Inspection, Testing and Commissioning

An advanced notice of at least 4 calendar days before commencement of inspection, testing or commissioning of any part or parts of the installation shall be provided.

The Contractor shall plan the testing and commissioning programme to enable the Architect or his representatives to witness all the tests. Unless otherwise approved by the Architect, testing and commissioning works carried out by the Contractor in the absence of the Architect or the Architect's representatives shall not be accepted as the approved contract test record.

D1.1.11 DOCUMENTATION AND DELIVERABLES

The Contractor shall record all commissioning information and testing results at the witness of the Architect or his representatives. Testing and commissioning shall be properly checked and certified by Contractor's CEIC and signed by the Architect or his representative who has witnessed the testing or commissioning before submission to the Architect. The Contractor shall submit full testing and commissioning report to the Architect within 14 calendar days after completion of testing and commissioning of the installation.

Immediately after each test, the CEIC shall sign the test/data record sheet, and obtain the endorsement of the Architect's representative who has witnessed the test on site, irrespective of whether the test is successful or not, and submit a copy of the test/data record sheet to the Architect. For testing that is required during the construction period, the Contractor shall also submit a formal testing and commissioning report endorsed by the CEIC within 14 calendar days after the completion of the whole test for any part of the installation.

D1.2 ADJUSTMENTS, COMMISSIONING, FUNCTIONAL AND PERFORMANCE TESTS

The Contractor shall make necessary adjustments, commission the installation, and carry out complete functional tests and performance tests on all installed equipment and systems, including the setting of controls and checking the operation of all protective and safety devices, in accordance with the manufacturers' recommendation, statutory requirements, and the approved procedures before the installation will be accepted.

The testing and commissioning shall include, but not limited to, the following: -

(a) Factory tests and off-site tests;

(b) Visual inspection and checking;

(c) Setting to work including safety and quality tests;

(d) Commissioning, regulating, tuning and adjustment;

(e) Functional tests;

(f) Performance tests;

(g) Final mock-up tests; and

(h) Statutory tests and inspections.

The Contractor shall program for a progressive testing and commissioning to achieve practical overall completion and have the whole work ready to be handed over by a date to suit the Contract completion date or any other agreed programme date.

The Contractor shall note that the completion of testing and commissioning of fire service installation to the satisfaction of the Architect and the satisfactory completion of all associated statutory inspections by the FSD are the important considerations for certifying completion of the Works. The Contractor shall prepare at early stage of the Contract a detailed plan and programme for the testing and commissioning works, in order to ensure that all the testing and commissioning works will be completed within the construction period and before the completion date of the Works.

Any defects of workmanship, materials and performance, maladjustments or other irregularities which become apparent during testing and commissioning, shall be rectified by the Contractor at no additional cost to the Employer and the relevant parts of the testing and commissioning procedures shall be repeated at the expenses of the Contractor.

During the inspection, testing and commissioning, the Contractor shall be required to demonstrate to the satisfaction of the Architect on the dismantling and access arrangement for any part or component of the installation for which, in the opinion of the Architect, have inadequate maintenance access. The Contractor shall be responsible for carrying out all necessary remedial work at no extra cost to the Employer to alleviate the difficulties associated with the dismantling or maintenance access when found.

D1.2.1 FACTORY TESTS AND OFF-SITE TESTS

Factory tests and off-site tests as required shall be carried out at the manufacturer's works places, at the laboratories by approved independent regulatory /testing bodies, or elsewhere as approved. This shall include quality control tests and general inspection tests in factory recommended by the manufacturer or for compliance with relevant standards.

Where required, 'type-test' on individual item of equipment to demonstrate its compliance with the Specification shall be conducted. 'Type-test' certificates shall be submitted in duplicate to the Architect.

Where indicated, performance test shall be carried out in factory for each of the offered equipment or for some equipment before delivery. After the performance test, factory test report/certificate certified by a qualified factory engineer shall be submitted in duplicate to the Architect for approval. The factory test report/certificate shall be submitted to the Architect immediately after the test and before the material or equipment is dispatched from the manufacturer's works place.

Factory test shall be witnessed by an independent approved agency/body where indicated.

The Contractor shall note that the Architect may require witnessing the tests and inspection of equipment under manufacturing at the manufacturer's works place. Where this requirement is indicated in the Contract, the Contractor shall allow for making the necessary arrangements.

D1.2.2 VISUAL INSPECTION AND CHECKING

Site inspection of 'works in progress' will be made by the Architect or the Architect's representative from time to time. The Contractor shall keep such inspection and test record for checking from time to time. Works to be permanently covered up shall be subjected to inspection, pressure test and other tests before cover up. During the inspection, if the Architect discovers any work that has been covered up before inspection and testing, this work shall be uncovered for inspection and testing to the Architect's satisfaction. The cost involved in uncovering the work, inspection, testing and re-concealing the work together with any consequential losses such as the re-program of work/acceleration of work shall be paid by the Contractor at no additional cost to the Employer. Any defective works and installation of poor workmanship found during visual inspection shall be rectified or replaced before proceeding with further tests.

Visual inspection and checking shall include the inspection and verification of the installed equipment being the approved brands and models. The Contractor shall submit relevant documents including delivery orders, payment vouchers, confirmation from manufacturers, factory test records, etc., to substantiate the equipment installed on Site being the approved brands and models if the identification of the manufacturer, model name, capacity and rating cannot be found or seen easily on Site.

D1.2.3 SETTING TO WORK, SAFETY AND QUALITY TESTS

Prior to the testing and commissioning works, the Contractor shall check the completion of the installation works, associated builder's work, RFSI, RFSP, and related building services installations, to ensure that commissioning can be proceeded without obstruction.

Before any installation is subjected to commissioning and site testing, it shall be thoroughly cleaned both internally and externally. All pipes shall be thoroughly cleaned and flushed before filling with water.

The Contractor shall be responsible for initially setting the plants to work including: -

(a) Preliminary checks to ensure that all systems and system components are in a satisfactory and safe condition before start up;

(b) Preliminary adjustment and setting of all plant and equipment consistent with eventual design performance;

(c) Carrying out pressure test, hydraulic test and other tests required before energising the equipment and plant;

(d) Checking the proper functioning of the protective devices and safety valves in the installation and carrying out all necessary safety testing;

(e) Energising and setting to work on all plants;

(f) Initial regulation and demonstration that the installation delivers the correct rate of flow at the conditions specified in the Contract.

For specialist plant or equipment, the Contractor shall arrange for it to be commissioned, certified and tested by the manufacturer's skilled commissioning engineer and/or technician.

Where the tests involved other fire service installations already in operation in other parts of the building outside the Site or works area, the Contractor shall co-ordinate with relevant parties, where necessary, on the temporary suspension of other fire service installations for the tests. The Contractor shall provide all necessary temporary precautionary measures to fulfil the fire safety requirements in such case at the expenses of the Contractor and be responsible to inform the FSD on the arrangement.

D1.2.4 COMMISSIONING, REGULATIONS, TUNING AND ADJUSTMENT

The Contractor shall regulate, balance, tune, commission and adjust the installation and equipment as appropriate and necessary to deliver the conditions and requirements as specified in the Contract. The Contractor shall allow carrying out such adjustment and re-adjustment as necessary until all the requirements are met and accepted by the Architect.

D1.2.5 FUNCTIONAL TESTS

The Contractor shall demonstrate to the satisfaction of the Architect the functioning of the installation, system and equipment complying with the operational and functional intent and the requirements in the Contract. The Contractor shall test and demonstrate the proper operational mode, control and the sequence of the operation in various parts of the system and installation.

The Contractor shall provide necessary measures to ensure that all water discharge in the test is properly drained to nearby drain points. All the smoke and gas generated shall also be vented outside the building after the test.

D1.2.6 PERFORMANCE TESTS

The Contractor shall carry out tests to prove the performance of the installation, system and equipment in term of flow, pressure, electrical current, sound level, and other technical/design aspects complying with the requirements in the Contract, relevant standards and the statutory requirements. The Contractor shall regulate, balance, tune, adjust and modify the installation, system and equipment as necessary till all the performance requirements are met. The final setting and operation parameters of all equipment shall be recorded.

Where necessary or as required, the Contractor shall carry out full load test by simulation method or other approved method to prove the performance of the installation at full load condition.

D1.3 WATER SYSTEM TESTS

Water systems and circuits shall be tested hydraulically to a minimum pressure of 1000 kPa or 1.5 times the working pressure whichever is higher applied at the highest point of the system and held for a period of not less than 15 min without leaks appearing.

All pipework shall be thoroughly cleaned and flushed before test. The Contractor shall ascertain that there is adequate drainage nearby to discharge by large hose in order to ensure flooding of low level areas will not occur. Where necessary, the Contractor shall provide chemical cleaning to the pipes. After flushing out the pipework, a flow test shall be performed on the hydrant/hose reel system in accordance with the requirements of the Code of Practice for Minimum Fire Service Installations and Equipment.

A water supply test with the drain and test valves fully opened shall be made on the sprinkler system in accordance with the requirements of the LPC Rules for Sprinkler Installations. An alarm test for at least 30 seconds on the water gong shall also be carried out by opening the test valve to ensure that it shall sound continuously after water flow in the system is detected. All controls and air supply system for the pre-action system, recycling pre-action system and dry pipe system shall be tested.

An actual water discharge test shall be performed on the drencher/deluge/water spray/water mist system and for other automatic fixed installations using water to test the water flow and discharge pattern of the nozzles.

For street hydrant system without pumps, the Contractor shall test the incoming water supply pressure at a nearby supply point and at such time as agreed with the Architect before the commencement of the installation works to establish the adequacy of the water supply pressure. If the supply pressure is inadequate, the Contractor shall propose remedial measures for the approval of the Architect. The Contractor shall find and select the most appropriate nearby supply point for the test.

The Contractor shall provide whatever hoses or drainage channels required to safely remove the test water discharged while carrying out these tests in order to ensure that no damage to the building and property will be caused by the test water.

The Contractor shall submit hydraulic test certificates/reports that shall be signed by the Contractor's CEIC and by the Architect or the Architect's representative who has witnessed the test. The test certificates/reports shall contain the following particulars: -

(a) Date of test;
(b) Apparatus or section under test;
(c) Makers number (if any);
(d) Nature, duration and conditions of test;
(e) Result of test;
(f) Name of Contractor's representative (in block letter) in charge of test;
(g) Name of Employer's representative at witness the test

D1.4 ELECTRICAL AND ALARM SYSTEM TESTS

Electrical wiring systems shall be tested generally as required by the General Electrical Specification, EE_TC and FS_TC. Extra low voltage wiring shall be insulation tested to a D.C. voltage of twice the normal working voltage of the system. Any tests that are liable to cause damage to the delicate components such as those incorporating electronic circuits shall be carried out with the components disconnected.

Smoke detectors shall be checked for correct sensitivity settings by means of manufacturer's test set and for operation by simulated smoke tests. The smoke detectors shall be tested and checked for correct settings after every cleaning and right after the occupation of the building.

Rate-of-rise heat detectors shall be tested by gentle application of a heat source such as hair dryer. Fixed temperature heat detectors must not be tested other than using simulated tests.

Each sensing element of the multi-sensor detectors shall be checked for correct sensitivity settings by means of manufacturer's test set approved by the Architect and for operation by simulated tests.

Soak test of least 1 week shall be carried out for all automatic detectors at the time after the completion of all works including fitting-out works and the whole area is cleaned up, normally at the time of occupation by users or immediately after. Such test shall deemed to be successful only if during such period no false fire alarm is occurred or necessary action has been taken to rectify the causes.

Battery capacity shall be tested by discharging through the alarm circuits and being charged via the incorporated charger unit. The specific gravity of the electrolyte shall be tested with a clean hydrometer where applicable. Battery voltage shall be checked.

The Contractor shall arrange power failure load tests to prove proper functioning of the fire service installation and the associated power supply changeover control during power failure and fire mode.

The input D.C. supply to the alarm supervisory circuitry shall be checked for correct voltage and stability such as to match the signal and alarm triggering devices.

For fire alarm direct link to the FSD or FSD's approved centre, the Contractor shall, unless approved by the Architect, initiate the fire alarm direct link applications to the appropriate agencies within 3 months after commencement of the Contract so that the fire alarm direct link will be connected and tested before the fire service inspections. The Contractor shall submit a copy of the application document to the Architect for record.

The Contractor shall co-ordinate and shall closely monitor the status of completion of fire alarm direct link and the telephone line before the fire service inspections by the FSD. The Contractor shall apply for and provide at the Contractor's own cost the required telephone point for connection of the fire alarm direct link as required. If the Contractor cannot complete the fire alarm direct link by the date of fire service inspection by the FSD, the Contractor shall be responsible to provide all necessary manpower and telephone equipment, at the Contractor's own expenses, solely for the purpose for a 24-hour/day full attendant service to substitute the fire alarm direct link, to the approval of the FSD and the Architect, up to the date of the completion of the fire alarm direct link.

The fire alarm direct link shall be tested after connection.

D1.5 GASEOUS EXTINGUISHING SYSTEM TESTS

Gaseous extinguishing system and manifolds shall be tested in accordance with Clause B5.13 and FSD Requirements and Circular Letters. Pipework shall be tested for 10 minutes to a minimum of 1.5 times the operating pressure of the system and 10 bars whichever is larger. A 'puff' test(s) to the installed pipework is required.

The Contractor shall allow carrying out on-site full discharge test after completion of the installation when required by the FSD to confirm the design conditions can be met and to the satisfaction of the FSD and approval of the Architect. The Contractor shall follow relevant FSD Requirements and Circular Letters on the requirements of discharge tests. The Contractor shall refill the gas cylinders with the design agents after the tests and reset all the equipment after the discharge test.

D1.6 EMERGENCY LIGHTING AND EXIT SIGN TESTS

Each self-contained luminaire and internally illuminated exit sign shall be energized from its battery by simulation of a failure of the normal supply to the lighting for a period of the rated duration of the battery. During this period all luminaires and/or signs shall be examined and tested in accordance with BS 5266-1: 2005 and BS EN 50172: 2004 to ensure that they are functioning correctly.

Each central battery system shall be energized from its battery by simulation of a failure of the supply to the normal lighting for a period of the rated duration of the battery. During this period all luminaires and/or signs shall be examined and tested in accordance with BS 5266-1: 2005, BS EN 50172: 2004 and BS EN 1838: 1999 and the requirements of the FSD to ensure that they are functioning correctly. All tests required in the Code of Practice for Minimum Fire Service Installations and Equipment and Inspection, Testing and Maintenance of Installations and Equipment, FS_TC and EE_TC shall be carried out and recorded.

For those emergency lighting system with battery and backed up by emergency generators, each emergency generator shall be started up and allowed to energize the emergency lighting system for a continuous period of at least 1 hour. During this period all luminaires and/or signs shall be examined visually to ensure that they are functioning correctly. The start up time of the generator and the illumination level in terms of `lux' and `cd/m^2' etc. shall be recorded and the Contractor shall ensure that the start up time matches with FSD's requirements.

For emergency lighting system and exit signs provided with central monitoring, testing and logging system, the system shall be tested in accordance with the manufacturer's specification and to meet the requirements in the FSDCoP, FS_TC and EE_TC.

Where indicated that there are emergency lighting installation and/or exit signs in a building carried out by others and not included in the Works under Fire Service Installation, the Contractor shall follow the requirements in Clause B11.1.12. The Contractor shall include the emergency lighting installation and exit signs as part of the fire service installation in the submission to the FSD with the necessary information to be provided by the relevant parties.

D1.7 EMERGENCY GENERATORS TESTS

The Contractor shall carry out full visual inspection, safety check, functional and performance test for the emergency generator installation. The tests shall include measurement on noise confirming compliance with the statutory requirements and/or as required by the Environmental Protection Department, the HKSAR. Emergency generators for fire service installation shall be located in separate room unless otherwise agreed by the FSD and approved by the Architect.

After full test of the fire service installations in a building or premises have been carried out, with all systems connected to the mains electricity supply, the mains electricity supply shall be switched off to simulate power failure and the emergency generator shall start automatically.

When the emergency generator has gained its capacity and is ready to accept the fire service load, each fire service installation shall be switched on until all installations are in operating conditions. If an automatic starting programme or device is provided for controlling the starting sequence of the equipment using emergency power supply, the programme or device shall be allowed to operate and test. A 'simultaneous running' test shall then take place and shall last for a continuous period of 1 hour. During this period, the performance of each fire service installation shall be monitored and recorded.

After 1 hour of testing, the emergency generator set shall be examined and all instruments, safety devices etc. shall indicate normal running of the generator.

The fuel tank shall be topped up after the tests.

Where the emergency generator installation is provided under the fire service installation, in addition to the tests required by the FSD, the Contractor shall test and commission the emergency generator installation complying with the requirements in General Electrical Specification and EE_TC.

Where indicated that there is emergency generator installation in the same building carried out by others and not included in the Works under Fire Service Installation, the Contractor shall follow the requirements in Clause B11.3. The Contractor shall include the emergency generator installation as part of the fire service installation in the submission to the FSD with the necessary information to be provided by the relevant parties.

D1.8 HOT SMOKE TEST

Hot smoke test shall be carried out where specified or required by the FSD. The Contractor shall arrange, co-ordinate and carry out the hot smoke test to meet the purpose for simulating the prototype of a real fire under specific dynamic buoyant flow of smoke and heat intensity in a controlled manner and for assessing the performance of smoke management system, smoke control system and smoke extraction system with the given building geometry. Hot smoke test shall follow FSD Circular Letter No. 2/2002, Australian Standard AS 4391-1999 "Smoke Management System – Hot Smoke Test" or approved international standards and practices and to the satisfaction of the FSD and the Architect. The Contractor shall obtain comments from the FSD and all relevant parties on the detailed requirements and arrangement for the hot smoke test at early stage of the Contract.

The Contractor shall provide all materials, equipment, facilities, fuels, manpower and the like for hot smoke test. The Contractor shall co-ordinate and arrange with the Building Contractor to provide all necessary temporary protection to the building finishes, parts, fixtures, furniture and other building works during the test. The Contractor shall submit the details of such requirements to the Building Contractor in good times before the test and to the Architect for approval. The Contractor shall supply and install all necessary protections and allow all appropriate provisions to other parts of the building not covered by the Building Contractor so as not to cause any damage, and to keep any disturbance to the possible minimum to any occupants or services during hot smoke test. The Contractor shall co-ordinate with the Building Contractor and the FSD and shall propose a suitable location and a suitable fire size to the approval of the FSD for carrying out the hot smoke test. The Contractor shall carry out a risk assessment of the hot smoke test and allow adequate protection and provisions for the risk. The Contractor shall employ a standby fire fighting team during hot smoke test for the purpose of fire safety. The Contractor shall deem to allow all necessary insurance coverage for the hot smoke test when such or any part of it is not covered under the general insurance policy of the Building Contractor for the Site.

The Contractor shall arrange and co-ordinate with relevant parties in carrying out the hot smoke test. The Contractor shall employ a qualified professional engineer to arrange the details and co-ordinate the hot smoke test. The engineer employed shall be a Registered Professional Engineer in Hong Kong under CAP 409 in building services or mechanical discipline or equivalent approved professional qualification.

Where hot smoke test indicates deficiency in smoke management system, smoke control system, smoke extraction system and the like included in the Works, the Contractor shall rectify them to the satisfaction of the FSD and the Architect at no additional cost. Where the smoke management system is not included in the Works, the Contractor shall report the deficiency to the Architect and propose improvement measures. The Contractor shall submit a detailed test report at the end of the test that shall include all the recommendations and improvement measures.

D1.8.1 GENERAL ARRANGEMENT

The hot smoke test can be conducted in existing buildings or in new development just prior to final completion. Until the specific performance requirements for the system can resemble the conditions under which the system is intended to operate including criteria as differential pressures, air velocities and exhaust rates etc., the hot smoke test shall be arranged for FSD's inspection.

All details on the arrangements / objectives / methods / apparatus / test set up of the required operational and functional tests shall be agreed with the FSD and be approved by the Architect before such test(s) be commenced. The submission shall include, but not limited to, the following items:

(a) Submission shall include drawings presented in the format as set out in the FSD Requirements and Circular Letters issued with associated schematic diagrams which fully explain the operation of the installations including at least information on "normal", "fire", and "no power" modes as well as a fully written description thereof.

(b) The Contractor shall submit proposal and list out the procedures for equipment set up, test process and safety precautions necessary for carrying out the hot smoke test. The full set up shall be carefully sized for safe application and simulation of the anticipated interior fire conditions to the building envelope including the dimension of equipment, the estimated quantity of fuel required to suit individual building geometry, acceptable designed fire size, fire load, active fire suppression system and fire growth rate etc.

(c) The Contractor shall submit all details, certificates etc. concerning the accuracy and reliability of all test equipment on item-by-item basis or on a complete system basis.

(d) The Contractor shall ensure that the installation of dynamic extraction systems shall be completed; satisfied the design intent and functioning correctly before the final full test and demonstration take place with the FSD.

(e) The Contractor shall submit full set of test and functional operation check records to and request for the attendance of the FSD. Accompanying the records, the submission shall be checked and signed by the Registered Professional Engineer employed by the Contractor stating the Registered Professional Engineer's satisfaction that the installations are operating in accordance with the requirements of the FSD.

(f) Full and complete records shall be taken of tests and the results thereof including not less than: -

(i) Make, serial no., type and owner of all instruments used, with a copy of the calibration certificates;

(ii) Data on actual measurements taken;

(iii) Data on corrected measurement, if any;

(iv) Data on resulting air flows;

(v) Make, serial no., type and use of every device checked;

(vi) Date and time of test;

(vii) Signature of operator or supervisor and any witness for each test; and

(viii) Signature on acceptance of whole system by the Registered Professional Engineer.

D1.8.2 HOT SMOKE TEST PREPARATION

The Contractor shall ensure all smoke management systems under normal operating mode shall be capable of handling the smoke volume generated during the test under reasonable time period to the satisfaction of the Architect and the FSD. Furthermore, the systems in the test compartment shall be operated continuously and shall be under closely monitoring such that no adverse internal environmental conditions caused by air stratification and air velocities are generated.

The format / method / procedures / apparatus of the required operational and functional test for hot smoke test shall be agreed with the FSD before any tests be commenced. The hot smoke test shall be used to validate the effectiveness of the smoke removal system against the following and with reference to the latest version of all corresponding international standards (e.g. AS 4391: 1999; NFPA 92A: 2006 etc.).

(a) The air flow patterns (i.e. scouring or cross flow effect with low level supply and high level extract).

(b) Smoke removal rate.

(c) Integration between smoke extraction and detection system.

The Contractor shall provide all test apparatus, equipment and materials for the test that shall include but not limited to the following. The Contractor shall agree with the FSD on the detail arrangement and any other extra equipment or apparatus used in performing the test and all details shall be submitted to the Architect for approval.

(a) Smoke generators;

(b) Fire chamber;

(c) Stainless steel tray for load cell; water bath & sand base;

(d) Combustion fuel;

(e) Temperature monitoring tree;

(f) Fire fighting equipment;

(g) Safety measures and procedure to be agreed with the FSD.

Some guidelines for hot smoke test are listed below for reference. The Contractor shall obtain the approval of the Architect and the FSD for the criteria used in respective test.

Test Fire Size	:	At least 1MW and as agreed by the FSD
Minimum Smoke Clear Height	:	2.5m
Temperature at Plume and Smoke Layer Interface	:	Not less than 10°C below temperature rating of ceiling sprinkler, around 45 °C to 50 °C maximum.
Combustion Fuel	:	Non-contaminating industrial grade methylated spirit
Smoke Generator	:	Non-toxic oil-based Type
Safety Measures	:	Fire Suppression Equipment & Personnel

D1.8.3 FIRE SAFETY DURING HOT SMOKE TEST

The Contractor shall prepare flowchart & working procedures for the hot smoke test and perform trial runs before the actual testing be conducted with the FSD. The Contractor shall employ a team of experienced fire fighters / fire watchers to the approval of the Architect to oversee the test procedure and who shall be present throughout the test. These personnel shall be equipped with full fire fighting apparel including self-contained breathing apparatus, fire extinguisher and charged fire brigade hose. The Contractor shall employ an auxiliary team of experienced fire fighters to the approval of the Architect fully equipped with fire fighting apparatus acting as the standby safety officers in order to monitor the impact of smoke movement, cumulative smoke layer and internal temperatures and to take all necessary action to ensure that the test will not generate any adverse effect caused to the observers and damage to the property.

The Architect or the Contractor can terminate the test if it is considered that continuation of the test may cause damage to the building or may have a great adverse effect to the people inside the building. The Contractor shall re-arrange the hot smoke test at no additional cost until the test is completed to the satisfaction of the Architect and the FSD. The Contractor shall ensure sufficient number of personnel station in appointed position to control the test fire and providing guidance to the observers / attendees. The Contractor shall provide sufficient training to all the Contractor's employees and staff present in the test to aware that prolonged exposure to tracer smoke may cause irritation and breathing difficulties.

The Contractor shall ensure that the temperature of hot smoke plume shall be carefully controlled for not causing damage to building structure and other finishing and not triggering the automatic sprinkler system.

D1.9 TESTS ON OTHER FIRE SERVICE INSTALLATIONS

Tests on fire service installations other than those in Clause D1.3 to Clause D1.8 shall be in accordance with EE_TC, FS_TC, FSDCoP and FSD Requirements and Circular Letters, and the approved detailed testing and commissioning procedures proposed by the Contractor and approved by the Architect. The Contractor shall propose and submit detailed testing and commissioning procedures for all fire service installations for approval by the Architect where such details of testing and commissioning are not available in EE_TC, FS_TC and FSDCoP, e.g. pressurization of staircases system, smoke extraction system etc. The detailed testing and commissioning procedures submitted shall be comprehensive and sufficient to demonstrate the functioning and performance of all the systems and equipment.

D1.10 FINAL MOCK-UP TEST

Before arranging inspections with the FSD, the Contractor shall arrange a final mock-up test with the Architect to demonstrate that all the items required for the fire service inspections by the FSD have been completed and tested to the satisfaction of the Architect. The final mock-up test shall be a full inspection test same as the fire service or statutory inspection to be conducted for the FSD.

Before the final mock-up test, the Contractor shall ensure that all the documents required for fire service or statutory inspections shall be available on Site.

Further mock-up tests shall be required if the installation fails to meet with the satisfaction of the Architect in the test. The Contractor shall not arrange inspection with the FSD till the satisfactory acceptance of the mock-up tests by the Architect. The Contractor shall allow adequate time in the testing and commissioning programme for re-testing of the whole fire service installation in case of failure. The Contractor shall indicate the final mock-up test and the fire service inspections by the FSD as the milestone events in the critical path programme to be submitted to the Architect at the commencement of the Works.

D1.11 FIRE SERVICES DEPARTMENT INSPECTIONS AND WITNESS OF TESTS

Additional tests, where not specified above, shall also be carried out to meet the requirements of the Codes of Practice for Minimum Fire Service Installations and Equipment to the satisfaction of the FSD and the Architect. The Contractor shall make all necessary applications to the FSD and attend inspections conducted by their representatives for the purpose of these tests and inspections. The Contractor shall note that completion of the inspection and acceptance of the fire service installation by the FSD is one of the considerations for certifying the completion of the Works.

D1.12 TESTING OF FIRE SERVICE INSTALLATION AND PROVISIONS INSTALLED BY OTHERS

Where indicated that there are fire service installation, RFSI and RFSP installed in the same building or project by others, the Contractor shall co-ordinate with relevant parties, inspect, check, and witness the final functional and performance tests of the fire service installations, RFSI and RFSP by others on their compliance with FSDCoP, FSD Requirements and Circular Letters, FS_TC, EE_TC, MoE, FRC, MoA and relevant statutory requirements. The inspection, checking and witnessing of the final tests on works by others shall confine to those items and aspects that are required for inspection by the FSD and/or required to satisfy the requirements of the FSD only.

The Contractor shall follow the requirements in Clauses B11.1.12, B11.3, B12.1 and B12.7.

Upon completion of the tests carried out and certified by others and with no non-compliance found by the Contractor, the Contractor shall include all the fire service installation of a building or project in the submission to the FSD for inspection. The Contractor shall co-ordinate, obtain the drawings and information from the relevant parties and include all fire service installations in the submission to the FSD for comment and inspection.

D1.13 CLEANING OF DETECTORS

During building construction and before testing and commissioning, the Contractor shall supply and install suitable temporary cover or protection to the detectors to protect them from dirt and dust after installation. Such temporary protection shall only be removed at the time of the tests and for inspection by the FSD. The Contractor shall clean all the detectors using manufacturers' recommended methods before the tests as well as before inspection by the FSD.

After inspection by the FSD and completion of all works including fitting-out works with the whole area cleaned up, normally at the time when the occupants start to move in or immediately after, the Contractor shall take down and clean "in-situ", and test if necessary, all the automatic detectors using cleaning methods in accordance with the manufacturer's recommendation. Cleaning of detectors is part of the testing and commissioning work and shall be carried out by the Contractor. The Contractor shall co-ordinate with relevant parties on the programme for carrying out such cleaning work and shall obtain the approval of the Architect especially when the occupants of the building may arrange fitting-out works. Cleaning of detectors carried out without notifying the Architect shall not be accepted and the Contractor shall be required to clean the detectors again no matter whether the Contractor has done so or not. Where the detectors are required to be factory-cleaned, all detectors removed for factory cleaning shall be temporarily replaced with spare units supplied by the Contractor to cover the unprotected areas as resulted. All expenses for the above work shall be borne by the Contractor.

After cleaning, the Contractor shall arrange the soak test for all the automatic detectors as required in Clause D1.4.

D1.14 TESTING AND COMMISSIONING REPORT AND CERTIFICATE OF COMPLETION

All testing and commissioning results shall be properly recorded during testing and commissioning at the witness of the Architect or the Architect's Representative. Immediately after the testing and commissioning, the Contractor's CEIC shall endorse the data record sheets on Site and obtain the endorsement of the Architect's representative witnessing the testing and commissioning, irrespective whether the tests are successful or not, and submit a copy of the data record sheets to the Architect. A full testing and commissioning report shall be forwarded to the Architect within 14 calendar days after completion of the testing and commissioning of the relevant installation.

The testing and commissioning report shall comply with the requirements in FS_TC, checklist contained in the FSDCoP, and as required by the FSD and the Architect. The report shall be checked, verified, and endorsed by the CEIC and certified by a Registered Professional Engineer in Hong Kong under CAP 409 in approved disciplines (or equivalent approved professional qualification) employed by the Contractor, except when approved by the Architect for minor installations, the report shall be checked, verified and endorsed by the CEIC and certified by a staff of the Contractor having the approved professional/technical qualification and experience.

Different parts of the report shall also be signed and certified by relevant parties such as registered electrical contractors/workers employed for the electrical fire service installation and electrical installation, registered professional engineers employed for the smoke extraction system, pressurisation of staircases, hot smoke test and emergency generator installation, relevant contractors of RFSI and RFSP, qualified persons for the surveyor certificates, design engineers as appropriate, independent checker where provided etc. The testing and commissioning report shall also be included as an appendix in the operation and maintenance manual.

Together with these, a certificate of completion signed by the Contractor shall be issued to the Architect with a copy of the certificate forwarded to the Director of Fire Services in conformity with Regulation 9 of the Fire Service (Installations and Equipment) Regulations.

PART E – INSPECTION, ATTENDANCE, OPERATION AND MAINTENANCE DURING MAINTENANCE PERIOD

SECTION E1

INSPECTION, ATTENDANCE, OPERATION, MAINTENANCE AND FINAL TESTING

E1.1 GENERAL MAINTENANCE REQUIREMENTS

The Contractor shall furnish free maintenance services for the complete fire service installation work in the Contract for the whole Maintenance Period unless otherwise specified. This free maintenance services shall include the following: -

(a) Routine quarterly inspections, tests and maintenance services, and routine inspections, tests and maintenance service as necessary;

(b) Emergency inspections, tests and repairs;

(c) Final inspections, tests and maintenance services, and annual inspections, tests and maintenance services; and

(d) All the services and requirements in Section E1

All inspections, tests, maintenance services and repairs shall be carried out generally in accordance with the manufacturers' recommendations/instructions and to the satisfaction of the Architect. The maintenance service is to maintain the fire service installation in good and functional working condition. The maintenance service shall include preventive maintenance services to all installed systems and all spare parts and spares required in the Maintenance Period. Additional spares and spare parts when ordered by the Architect are for the use after the Maintenance Period only.

The Contractor shall despatch competent and experienced engineers and technicians equipped with appropriate testing instruments, tools, equipment etc. to inspect, service, test, adjust, repair and maintain the fire service installation in a satisfactory operating condition. The Contractor shall allow for carrying out such inspection, service, testing, adjustment, repair and maintenance at a time outside normal office hours including general holidays where and when required. The Contractor shall submit a list with at least two names, telephone and pager numbers and addresses of the Contractor's English-speaking and Cantonese-speaking representative to who services calls should be directed.

Particularly in the case of complex fire service installation, the Contractor shall provide at least two senior servicemen being thoroughly familiarised with all aspects of such installation to be responsible for emergency repair, inspection, maintenance and testing of the installation. In this type of installation the Contractor must be prepared to provide a high level of service, to allow for more frequent service of environmentally sensitive equipment, and to ensure prompt rectification of the faults or high rate of false fire alarms all at the expenses of the Contractor.

All labour and materials necessary, e.g. fire alarm contacts, detectors, bells, buzzers, batteries, lamp bulbs etc., including cleaning materials, lubricants, battery electrolyte, tools, instruments, consumables, spares, replacement of parts etc., and transportation required for carrying out routine and emergency inspections, tests, repairs, replacements and maintenance services shall be included in the Contract. Any renewals or repairs necessitated by reason of misuse of the equipment or by reason of any other cause beyond the Contractor's control such as vandalism (with the exception of ordinary wear and tear) will be carried out at an additional cost with prior notice to and approved by the Architect.

The Contractor shall also replenish at the Contractor's own cost all fire extinguishing media and other materials expended or used during the tests including diesel or petrol fuel and ensure that the entire installations are in a satisfactory operational condition at the conclusion of each visit. The Contractor shall be responsible for all payment, costs and charges for connecting and maintaining the fire alarm direct link for the fire service installation in the Maintenance Period.

All materials and equipment reaching expiry date of service life shall be replaced.

The Contractor shall be responsible for all repairs and replacement necessary to maintain the fire service installation in a safe, reliable and operative condition at all times. The Contractor must ensure that the Contractor's servicing staff shall carry out the necessary repairs by utilising manufacturer's original replacement parts.

The Contractor shall ensure minimum interruption to the functioning of the fire service installation during each inspection, test, adjustment, repair or maintenance service. The Contractor shall inform the FSD of the commencement and completion of each job whenever the disconnection, reconnection or testing of the fire alarm direct link is involved.

Where any part of the fire service installation is out of service temporarily during the progress of work, the Contractor shall inform the FSD and place a suitable notice in a prominent position on the control panel so that the client/occupiers are aware of the situation and the FSD will not be called out unnecessarily. This is, however, not to be construed as an authority to leave any part inoperative for an undue length of time. The Contractor shall arrange necessary temporary facilities, protection, and fire safety precautionary measures in all affected areas to the satisfaction of the Architect, landlord/client/occupiers and the FSD during the work period and shall advise the client/occupiers to stay alert and to make corresponding management action.

Where the repair and maintenance works require temporary suspension of parts of the fire service installation inside or outside the Site such as in landlord's area, the Contractor shall obtain landlord's and relevant parties' consent, inform the FSD and shall provide all necessary temporary facilities, protection, and fire safety precautionary measures in all affected areas to the satisfaction of the Architect, landlord/client/occupiers, and the FSD during the suspended period and shall advise the landlord/client/occupiers to stay alert and to make corresponding management action. The Contractor shall be responsible for all the expenses for the completion of the repair and maintenance works.

The Contractor shall, as and when instructed by the Architect, repair or replace at the Contractor's own cost any part of the system proven to be defective by reason of Contractor's negligence, faulty design, latent defect, and inadequate routine maintenance, supervision, workmanship or materials. No claim whatsoever shall be made by the Contractor for such repair or replacement if it is within the scope of the Contractor's responsibility.

After each routine quarterly inspection, testing and maintenance service, the Contractor shall furnish to the Architect within 14 calendar days a report complete with the following details: -

(a) Date and time of inspection, testing and maintenance service;

(b) Persons carrying out the task;

(c) Details of inspection and maintenance service;

(d) Results of all tests performed;

(e) Any external factors significantly affecting the service and test results;

(f) Any follow-up actions as required;

(g) The record of all fault callouts in Clause E1.2 since last routine quarterly inspection, testing and maintenance service;

(h) The record of the fire alarm direct link being temporarily disconnected since last routine quarterly inspection with date and time.

The Contractor shall, at the Contractor's own cost, make all suitable arrangements to avoid damage to property or installations provided by others during the course of the Works. The Contractor shall be responsible for all losses and claims for injury or damage to any person or property whatsoever which may arise out of or in consequence of the execution of the repair and maintenance of the Works.

A log book shall be provided by the Contractor and retained in the fire service plant room, fire control centre, management office or building supervisor's office as approved by the Architect for recording all events of the fire service installation in the Maintenance Period. The Contractor shall record all the details of operation: faults and corrective actions taken, routine servicing, maintenance and periodic operation, inspection, testing, repairs, replacement, results, actions etc.; including dates, time of calls, time of attending, meter readings, cause of faults, time to remove faults, workers/supervisors names and signatures, location and identification of faults, description of equipment serviced etc. for all the fire service equipment, materials, system and installation. The Contractor shall also record the date, time and period on any temporary disconnection of the fire alarm direct link and any temporary suspension of any part of fire service installation in the log book and in the routine quarterly report submitted to the Architect.

No replacement of plant or parts of plant shall be carried out at any time unless the Architect has been notified and given approval.

Where there is any fire retardant paint or spray applied on Site to any surface by the Contractor to meet with requirements of the rate of surface spread of flame, the fire retardant paint/spray shall be repainted or re-sprayed by the Contractor at the end of Maintenance Period.

The Contractor shall carry the final inspection, testing and maintenance of the fire service installation at the end of the Maintenance Period.

Where the Maintenance Period is longer than one year, the Contractor shall also carry out the annual inspection, testing and maintenance of the fire service installation annually within the Maintenance Period complying with the requirements of the FSD/Building Authority and issue the relevant inspection certificates. The requirements of the annual inspection, testing and maintenance shall be the same as that of the final inspection, test and maintenance unless otherwise required by the FSD.

Where there are fire service installations carried out by others and not included in the Works under Fire Service Installation, the Contractor shall co-ordinate with relevant parties and collect the information on the final/annual inspection/testing on fire service installations by others to confirm their compliance with the requirements of the FSD. Any works/maintenance works found not complying with the requirements of the FSD shall be reported to the Architect.

E1.2 EMERGENCY INSPECTIONS, TESTS AND REPAIRS

Emergency service including overtime work for minor repairs and adjustments shall be included under the Contract.

The Contractor shall be responsible for immediate answering of breakdown calls during the day or night including public holidays, whether true or false, and attention to such calls both inside and outside the normal working hours in the shortest possible time and using the quickest means of transport. In general a response time of less than 1 hour will be expected unless special arrangement is made and approved for very remote locations.

Any necessary repairs shall be carried out with the most practicably expeditious means to ensure minimum interruption to the operation of the fire service installation.

Any component taken down for services shall be repaired, test and then reinstated within 2 hours. Should the repair work cannot be completed within 2 hours, the Contractor shall replace the defective parts by utilising manufacturer's original replacement spare unit(s) at the Contractor's expenses.

Should the manufacturer's original replacement spare unit is not available for immediate replacement, the Contractor shall isolate the defective parts of the system immediately to ensure that the proper functioning of the other parts of the installed fire service system would not be affected. The Contractor shall then submit a remedial proposal detailing the proposed defects rectification method and time needed for Architect's approval within 24 hours of the fault identification. Upon approval from the Architect, the Contractor shall carry out the remedial work following the agreed program and method at Contractor's own cost and at the same time responsible for all consequential losses and claims for injury or damage to any person or property arises out of or in consequence of the system failure.

The Contractor shall arrange to refill the gas cylinders for the gaseous extinguishing system upon discharge and put the system into normal operation within a time as short as possible but in no case shall be longer than 7 calendar days. Unless otherwise there are evidences that the discharge of gases in the gaseous extinguishing systems is due to a fire, smoke that generated a fire alarm, or the default operation/act of the occupiers of the building, the cost for refilling the gas cylinders of the gaseous extinguishing systems after discharge in the Maintenance Period including after false fire alarms shall be borne by the Contractor.

The Contractor shall keep a clear and legible record of all fault callouts and shall submit this record within 3 calendar days upon request by the Architect for inspection. The Contractor shall also include the record of all fault callouts in the report in Clause E1.1 submitted after each routine quarterly inspection, testing and maintenance service. The record shall indicate the date, time of callout, time of attending, persons attending, brief description of the fault, location/identification of fault, cause of fault, and subsequent time of clearance for each occasion. The record will be returned to the Contractor after perusal by the Architect but shall subsequently be submitted and kept by the Architect at the end of the Maintenance Period during the handover inspection of the installation.

E1.3 ROUTINE QUARTERLY INSPECTION, TESTING AND MAINTENANCE OF FIRE DETECTION AND ALARM SYSTEM

The Contractor shall visit the installation at least once every 3 months to carry out tests, repairs, maintenance and adjustments. All environmentally sensitive devices, e.g. smoke and heat detectors, air filters at the end of the probes for duct type detectors, electronic sensors, relay contacts, plug and socket contacts, printed circuit boards, edge connectors etc. shall be inspected, cleaned, adjusted, tested and calibrated. During the visits, the following tests and checks shall be made: -

A test sequence shall be carried out in accordance with the manufacturer's instructions. The test sequence shall prove: -

(a) That the condition of the wiring, controls and indicating equipment of all zone circuits are in good working order;

(b) That the alarm condition on each zone will activate the common alarm circuits. If manual call points are fitted the alarm conditions shall also be initiated by the operation of one such call point in each zone. A different manual call point shall be used on each occasion and a record must be kept by the Contractor;

(c) That activating the common alarm circuits will result in the operation of the alarm bells and the satisfactory transmission of the alarm signal to the FSD or FSD's approved centre if equipped with a fire alarm direct line connection; and

(d) That activating the common alarm circuits will result in the starting/stopping of the ventilating fans and/or fire booster pumps as desired and result in the initiation of any lift operation, if control circuits for such operation are provided in the system.

The operation of alarm bells and the transmission of the alarm signal may be suppressed during tests (a) and (b). Test (c) and (d) will prove that all system alarms and relevant controls are operating correctly.

In the course of the test sequence, the correct operation of all indicators including fault warnings and all alarm bells shall be noted and checked. All indicating lamps shall be checked and if found defective shall be replaced by the Contractor at the Contractor's own expenses.

About 20% of the detectors chosen at random with at least one unit in each zone shall be subjected to a simulated functional test. Smoke detectors shall be tested with simulated smoke, and rate-of-rise heat detectors with an artificial heat source, e.g. hair dryer.

Batteries and chargers shall be examined and tested to ensure they are in good and proper serviceable condition. Battery terminals and connectors shall be tightened and the former shall be cleaned and protected with petroleum jelly. Electrolyte shall be topped up as necessary and its specific gravity shall be measured and corrected to the appropriate value if required. Batteries shall also be discharged and recharged to ensure compliance with the specified requirements. Battery service life shall be checked and batteries shall be replaced as necessary. The Contractor shall send all used batteries for disposal to approved collectors or agencies in Hong Kong for recycling purpose.

When false fire alarm from the fire detection system is reported or found in the Maintenance Period, the Contractor shall take down, clean 'in-situ" and test all detectors in the Works irrespective whether such detectors have caused the alarm. All detectors that cannot pass the test or cannot be cleaned shall be replaced with new one at the expenses of the Contractor. Where the detectors are required to be factory-cleaned, all detectors removed for factory cleaning shall be replaced with spare units to cover the unprotected areas as resulted. All expenses for the above work shall be borne by the Contractor. The Contractor shall check and re-adjust the setting of the detector and control panel as necessary. The Contractor shall also check and identify the causes of the alarm and submit a full report to the Architect. All faults shall be rectified immediately to the satisfaction of the Architect and the FSD. All alarms reported shall be recorded in the log book and in the routine quarterly report submitted to the Architect. The report shall in particular highlight the investigation, recommendation and the rectification action carried out for the following circumstances: -

(a) If the rate of false fire alarms in the Maintenance Period or since the time of last inspection has exceeded the rate of one false fire alarm per 100 alarm initiating devices or exceed the rate of one false fire alarm per 80 detectors per annum;

(b) If more than three false fire alarms have occurred within the previous 6 months;

(c) If two or more false fire alarms have arisen from any single detector or manual call point or sprinkler flow switch since the time of last inspection;

(d) If any persistent cause of false fire alarm is identified.

If the reasons for false fire alarms can be established, the Contractor shall implement measures and carry out maintenance work such as cleaning, adjustment, etc. to the approval of the Architect to eliminate similar causes of false fire alarms in all other detectors/initiating devices in the building including those not having any false fire alarms reported yet.

E1.4 FINAL/ANNUAL INSPECTION, TESTING AND MAINTENANCE OF FIRE DETECTION AND ALARM SYSTEM

At the final/annual inspection, the Contractor shall, in addition to the quarterly inspection and testing, take down all smoke detectors, clean them 'in-situ' in accordance with the manufacturer's instructions, test them for correct operation and functioning with the manufacturer's test set before reinstate them for service. Any defective detectors shall be replaced or 'factory cleaned' in accordance with the manufacturer's recommendation before reinstated for service. Any smoke detectors subjected to dust and dirt accumulation shall be despatched for factory cleaning or as instructed by the Architect. All detectors removed for factory cleaning shall be replaced with spare units or alternatively a separate surveillance system shall be supplied and installed to cover the unprotected areas as resulted. All expenses for the above work shall be borne by the Contractor. All equipment reaching expiry date of service life shall be replaced.

E1.5 ROUTINE QUARTERLY INSPECTION, TESTING AND MAINTENANCE OF GASEOUS EXTINGUISHING SYSTEMS

The Contractor shall visit each installation at least once every 3 months and carry out the following tests including necessary repairs and adjustments: -

(a) All electrical components, including cables, detectors, relays, alarm panel and bells, batteries etc. shall be tested and examined as specified in Clause E1.3;

(b) All automatic/manual release mechanism shall be checked and serviced in accordance with the manufacturer's instructions to ensure their proper operation. The Contractor shall be responsible for ensuring that all such mechanisms are properly lubricated and kept free from corrosion;

(c) All pipes and fittings shall be checked for leakage and corrosion and repaired or repainted as necessary. All valves shall be checked for freedom of operation and nozzles shall be cleaned by removing the dust, dirt and other obstacles deposited on them;

(d) All cylinders containing the chemical extinguishing agents shall be checked to ensure that the contents are up to the specified standard and are so marked with paint on the outside of cylinders. The Contractor shall recharge any cylinders to the specified content level if carbon dioxide cylinders are found to exhibit a 10% loss and other gas cylinders a 5% loss of content by weight. Where the discharge is due to a genuine fire or the default operation/act of the occupiers, recharging of cylinders will be carried out at an additional cost with prior notice to and approved by the Architect. However, where the discharge is due to a faulty detector or other equipment of the system causing false fire alarm, the Contractor shall recharge the system at the Contractor's own expenses;

(e) All warning notices and operating instructions shall be checked to ensure that they are fixed in the proper position, are in a readable condition and are both in English and Chinese unless otherwise confirmed in writing by the Architect;

(f) All time delay and lock-off devices shall be inspected and tested to ensure that they are in correct working condition;

(g) The coincident unit shall be checked for proper function by actuating detectors of two separate zones; and

(h) All ancillary functions of the system such as shutting off air-conditioning/ventilation plant, lowering fire shutters/dampers or curtains etc. shall be checked for proper operation.

E1.6 FINAL/ANNUAL INSPECTION, TESTING AND MAINTENANCE OF GASEOUS EXTINGUISHING SYSTEMS

The Contractor shall carry out the same amount of work as the quarterly inspection, testing and maintenance services. All equipment reaching expiry date of service life or going to reach such expiry date within 3 months after the Maintenance Period shall be replaced.

E1.7 ROUTINE QUARTERLY INSPECTION, TESTING AND MAINTENANCE OF FIXED FIRE PROTECTION SYSTEMS USING WATER AS AN EXTINGUISHING AGENT

The Contractor shall visit the installation at least once every 3 months and carry out the following inspections, tests, adjustments and repairs: -

(a) All electrical components including cables, alarm panel and bells, batteries, control relays, starters etc. shall be inspected and tested as specified in Clause E1.3;

(b) All pipes and fittings shall be checked for leakage and corrosion and repaired or repainted as necessary. All valves shall be checked for freedom of operation, all control valves kept locked in the 'open' position by strapping as applicable, inlet valves correctly bonded to earth, water supplies maintained in service etc.;

(c) Inspection shall be carried out to ensure that all sprinkler heads are maintained in good working condition, clean and free from corrosion and are not covered with distemper, paint, dust, fluff etc. Any sprinkler heads found defective and suspected of being defective shall be replaced;

(d) Water and air pressure gauges must be inspected to ensure that correct pressures are maintained. Gauges shall be calibrated at regular intervals. Water levels and air pressure in pressure tanks must be checked to ensure that they are maintained in proper condition;

(e) An alarm test shall be made on the sprinkler system by opening the test valve and the time taken to sound the alarm gong noted. The alarm shall be allowed to ring for about 30 seconds in order to ascertain that it is not ringing intermittently. Any repairs or adjustments that may prove to be necessary after the test shall be carried out with no delay;

(f) All metallic elevated, priming and pressure tanks constructed by the Contractor shall be inspected for sediments, rust and corrosion. The Contractor shall remove sediments, rust and repaint the corroded parts as necessary;

(g) The Contractor shall grease the valves, the bearing and other relevant mechanical parts of the pumps, motors and engines as recommended by the manufacturers. An automatic pump starting test and a test run of at least 10 minutes shall be performed on each pump to ensure the pumping systems are in satisfactory operating condition. Engine driven pumps shall be capable of starting in 30 second or less. All manual and automatic starting and control mechanism, components, switches etc. shall be checked for proper functioning;

(h) All sprinkler flow switches shall be checked for correct functioning;

(i) All water tanks shall be checked for filling with water; and

(j) All water check meters for fire service installation shall be checked and recorded to see any abnormal large consumption of water in the period.

The Contractor shall replace as required all parts such as bearings, valve seats, packing etc. due to wear and tear. In addition the Contractor shall maintain in good working order the engines, the motors and the electrical power supply to the pumps from its electrical isolator or switch, including changeover switches, starters, fixed and flexible conduits between isolator/switch and cables therein. The Contractor shall also maintain all pump control pressure and level switches in good order and inspect circuitry as previously indicated for electrical systems. All drain valves shall be checked to be in the close position.

E1.8 FINAL/ANNUAL INSPECTION, TESTING AND MAINTENANCE OF FIXED FIRE PROTECTION SYSTEMS USING WATER AS AN EXTINGUISHING AGENT

At the final/annual inspection, the Contractor shall, in addition to the quarterly inspection and testing, carry out the following inspections, tests, adjustments and repairs as required: -

(a) Inspection and testing, by means of wet drill on the hydrant and hose reel installation, shall be carried out in accordance with the Fire Services Department requirements. The wet drill shall consist of coupling lengths of hose to two or more hydrants and opening the valve to produce water at the nozzles. Great care and precise liaison with all concerned must be exercised by the Contractor to guard against flooding and seepage of water. The Contractor shall be liable to bear the full cost of any damage due to flooding and seepage of water.

Hydrants not used at the wet drill shall each be fitted with a blank cap over the outlet, and checked by opening and closing the valve and spindle to ensure that they are free in operation.

Testing of the pressure and flow of the water supply on the hydrant and hose reel installation shall be done for the outlets at the highest point or at the lowest static pressure location. The opening of two or more outlets and directing the water from the roof tanks is sufficient to indicate the state of the water supply, but if there is any doubt as to the flow or pressure of the water, a more accurate test with suitable gauges shall be carried out.

After the test or wet drills, care shall be taken to see that the hose is thoroughly drained, dried and aired before being replaced in position.

(b) Each length of hose shall be uncoiled, laid out straight and examined, particular care being taken to see that the washers in the female couplings are intact and in good condition and that the hose is not damp or attacked by mildew.

(c) Each water supply to the sprinkler installation shall be tested individually. Before making the test on any one water supply, it is necessary to shut off all the other supplies. The test shall be made with the drain and test valves fully open in accordance with the requirements of the LPC Rules for Sprinkler Installations.

(d) After shutting off all water supplies and draining the installation via the flow test/drain valve, the Contractor shall remove the sprinkler control valve front cover to inspect and maintain its internal components. The work shall include checking the freedom of movement of the main clapper assembly and cleaning as required, greasing and replacing worn seals and gaskets, replacing all valve glands as necessary and replacing any worn seats in small bore valves etc. The sprinkler control valve front cover shall then be replaced and the installation shall be re-commissioned.

(e) The concrete water tanks constructed by the builder shall be inspected for rusting and sediments. The Contractor shall inform the Architect in writing if any cleaning and rectification on the tanks are necessary.

E1.9 ROUTINE WEEKLY/MONTHLY INSPECTION, TESTING AND MAINTENANCE OF EMERGENCY LIGHTING AND EXIT SIGNS

The Contractor shall visit each installation at least once every month (or once every week if weekly voltage test on emergency luminaire is involved) and carry out the following tests including necessary repairs and adjustments: -

(a) Each self-contained luminaire and internally illuminated exit sign shall be energized from its battery by simulation of a failure of the supply to the normal lighting for a period of at least 1 minute at 10-hour discharge rate and sufficient to ensure that each lamp is illuminated. The period of simulated failure shall not exceed one quarter of the rated duration of the fully charged battery or sign. During this period all luminaires and/or signs shall be examined and tested in accordance with BS 5266-1: 2005 and BS EN 50172: 2004 (or tested by the Central Monitoring, Testing and Logging System as mentioned in Clause B11.1.7) to ensure that they are functioning correctly and giving out the designed illumination level in 'lux' and 'cd/m^2'. At the end of this test period the supply to the normal lighting shall be restored and any indicator lamp or device checked to ensure that it is showing that the normal supply has been restored.

(b) Each central battery system shall be energized from its battery by simulation of a failure of the supply to the normal lighting for a period of at least 1 minute at 10-hour discharge rate and sufficient to ensure that each lamp is illuminated. The period of simulated failure shall not exceed one quarter of the rated duration of the fully charged battery. During this period all luminaires and/or signs shall be examined and tested in accordance with BS 5266-1: 2005 and BS EN 50172: 2004 (or tested by the Central Monitoring, Testing and Logging System as mentioned in Clause B11.1.7) to ensure that they are functioning correctly. All tests required in the Code of Practice for Minimum Fire Service Installations and Equipment and Inspection, Testing and Maintenance of Installations and Equipment shall be carried out and recorded. At the end of this test period the supply to the normal lighting shall be restored and any indicator lamp or device checked to ensure that it is showing that the normal supply has been restored.

(c) For emergency lighting system backed up by emergency generators, the emergency lighting shall be tested during on-load test of the emergency generator. After the emergency generator was started up, it shall be allowed to energize the emergency lighting system for a continuous period of at least 1 minute and sufficient to ensure that each lamp is illuminated. During this period all luminaires and/or signs shall be examined visually (or tested by the Central Monitoring, Testing and Logging System as mentioned in Clause B11.1.7) to ensure that they are functioning correctly and giving out the designed illumination level in 'lux' and 'cd/$m^{2'}$. At the end of this test period the normal supply to the lighting shall be restored and any indicator lamp or device checked to ensure that it is showing that the normal supply has been restored.

Where central battery system is supplied and installed, the Contractor shall in addition visit the installation at least once every week and carry out weekly voltage and hydrometer test as required in the Code of Practice for Minimum Fire Service Installations and Equipment and Inspection, Testing and Maintenance of Installations and Equipment.

Clause B11.1.7 where relevant shall also be followed and carried out.

E1.10 FINAL/ANNUAL INSPECTION, TESTING AND MAINTENANCE OF EMERGENCY LIGHTING AND EXIT SIGNS

The Contractor shall carry out the following tests annually and at the end of the Maintenance Period including necessary repairs and adjustments: -

(a) Each self-contained luminaire and internally illuminated exit sign shall be energized from its battery by simulation of a failure of the normal supply to the lighting for a continuous period of at least half of the rated duration of the fully charged battery. During this period all luminaires and/or signs shall be examined and tested in accordance with BS 5266-1: 2005 and BS EN 50172: 2004 to ensure that they are functioning correctly and giving out the designed illumination level in 'lux' and 'cd/m^{2}'. At the end of this test period the normal supply to the lighting shall be restored and any indicator lamp or device checked to ensure that it is showing that the normal supply has been restored.

(b) Each central battery system shall be energized from its battery by simulation of a failure of the normal supply to the lighting for a continuous period of at least half of the rated duration of the fully charged battery. During this period all luminaires and/or signs shall be examined and tested in accordance with BS 5266-1: 2005 and BS EN 50172: 2004 to ensure that they are functioning correctly. All tests required in the Code of Practice for Minimum Fire Service Installations and Equipment and Inspection, Testing and Maintenance of Installations and Equipment shall be carried out and recorded. At the end of this test period the normal supply to the lighting shall be restored and any indicator lamp or device checked to ensure that it is showing that the normal supply has been restored.

(c) For those emergency lighting system backed up by emergency generators, the emergency lighting shall be tested during on-load test of the emergency generator. After the emergency generator was started up, it shall be allowed to energize the emergency lighting system for a continuous period of at least 10 minutes. During this period all luminaires and/or signs shall be examined visually to ensure that they are functioning correctly. The test shall be repeated for 5 minutes with the emergency generator shut off and the lighting supplied by the battery system only. At the end of the test period the normal supply to the lighting shall be restored and any indicator lamp or device checked to ensure that it is showing that the normal supply has been restored. The fuel tanks shall be filled up and the oil and the coolant levels topped up as necessary.

Batteries and chargers shall be examined and tested to ensure they are in good and proper serviceable condition. Battery terminals and connectors shall be tightened and the former shall be cleaned and protected with petroleum jelly. Electrolyte shall be topped up as necessary and its specific gravity shall be measured and corrected to the appropriate value if required. Battery service life shall be checked and batteries shall be replaced as necessary. The Contractor shall send all used batteries for disposal to approved collector or agency in Hong Kong for recycling purpose.

Where the emergency lighting installation and/or exit signs are carried out by others and not included in the Works under Fire Service Installation, the Contractor shall co-ordinate with relevant parties and collect the information on the final/annual inspection/testing on emergency lighting installation/exit signs to confirm their compliance with the requirements of the FSD. Any works/maintenance works found not complying with the requirements of the FSD shall be reported to the Architect.

All equipment reaching expiry date of service life shall be replaced.

E1.11 ROUTINE MONTHLY INSPECTION, TESTING AND MAINTENANCE OF EMERGENCY GENERATORS

The Contractor shall visit each installation at least once every month and carry out the following tests including necessary repairs and adjustments: -

The emergency generator shall be run once per month under design load conditions for a period of not less than 30 minutes. During this running period all operating conditions shall be checked. Following this running period functional tests shall be carried out on all automatic and manual starting devices and safety controls.

The Contractor shall record all the details of operation: faults and corrective actions taken, routine servicing, maintenance and periodic operation, inspection, testing, repairs, results, actions etc.; including dates, time of calls, time of attending, meter readings, cause of faults, time to remove fault, workers/supervisors names and signatures, location and identification of faults, description of equipment serviced etc. in the log book in Clause E1.1.

E1.12 FINAL/ANNUAL INSPECTION, TESTING AND MAINTENANCE OF EMERGENCY GENERATORS

The Contractor shall carry out the following tests including necessary repairs, maintenance and adjustments: -

The emergency generator shall be run under design load conditions for a period of at least 1 hour. During this running period all operating conditions shall be checked. Following this running period functional tests shall be carried out on all automatic and manual starting devices and safety controls.

Where the emergency generator installation is carried out by others and not included in the Works under Fire Service Installation, the Contractor shall co-ordinate with relevant parties and collect the information on the final/annual inspection/testing on the emergency generator to confirm their compliance with the requirements of the FSD. Any works found not complying with the requirements of the FSD shall be reported to the Architect.

E1.13 QUARTERLY AND FINAL/ANNUAL INSPECTION AND MAINTENANCE OF PORTABLE FIRE EXTINGUISHERS

Portable fire extinguishers and appliances supplied and installed by the Contractor shall be inspected and checked quarterly to ensure that they are in good working condition. Any extinguisher and appliance found not in proper working condition shall be reconditioned and/or recharged/replaced to the required standard. All equipment reaching expiry date of service life shall be replaced. At the final inspection and maintenance, all portable fire extinguishers and appliances going to reach the expiry date within 3 months after the Maintenance Period shall be replaced.

E1.14 INSPECTION, TESTING AND MAINTENANCE OF OTHER FIRE SERVICE INSTALLATION

The Contractor shall carry out routine quarterly and final/annual inspection, testing and maintenance of all other fire service installation. The inspection, testing and maintenance shall follow the statutory requirements, the recommendation of the manufacturers, good engineering practice in the fire service trade, the relevant standards and this General Specification to maintain the fire service installation in an operable and functional status.

E1.15 CERTIFICATE OF MAINTENANCE

After completion of the final inspection, testing and maintenance service to the fire service installation at the end of the Maintenance Period to the satisfaction of the Architect, the Contractor shall within 14 calendar days issue to the Architect a certificate of maintenance signed by the Contractor with a copy forwarded to the Director of Fire Services. Where the Maintenance Period is longer than one year, the Contractor shall also submit to the Architect a certificate of maintenance after the completion of each annual inspection, testing and maintenance to the satisfaction of the Architect with a copy forwarded to the Director of Fire Services in compliance with the requirements of the FSD.

E1.16 HANDOVER OF FIRE SERVICE INSTALLATION

The fire service installation shall not deem as acceptable for handover to the Architect until the installation is in good working order and all as-built drawings, instruction and maintenance manuals, spare parts lists, test reports, test certificates etc. have been submitted to the Architect.

ANNEX I

LIST OF TECHNICAL STANDARDS AND QUALITY STANDARDS QUOTED IN THIS GENERAL SPECIFICATION

The following is a list of technical standards and quality standards quoted in this General Specification. The technical standards and quality standards indicate the basic requirements. The Contractor may offer products, materials and equipment complying with alternative internationally recognized equivalent standards acceptable to the Architect and demonstrated to be equivalent in terms of construction, functions, performance, general appearance and standard of quality to the relevant standards or other standards specified in this General Specification to the Architect for approval.

Standard	Description
ANSI B1.20.1:1983	Standard for pipe threads, general purpose
AS 4391: 1999	Smoke Management Systems – Hot Smoke Test
ASTM A53/A53M: 2006	Standard Specification for pipe, steel, black and hot-dipped zinc-coated, welded & seamless
ASTM A106/A106M: 2006	Standard Specification for Seamless Carbon Steel Pipe for High-temperature Service
ASME/ANSI B31	Code for piping
BS 143 & 1256: 2000	Threaded pipe fittings in malleable cast iron and cast copper alloy
BS 336: 1989	Fire hose couplings & ancillary equipment
BS 381c: 1996	Colours for identification, coding & special purposes
BS 476-7: 1997	Fire tests on building materials and structures. Method of test to determine the classification of the surface spread of flame of products
BS 1042-1.4: 1992	Measurement of fluid flow in closed conduits. Pressure differential devices. Guide to the use of devices specified in Sections 1.1 and 1.2
BS 1552: 1995	Specification for open bottomed taper plug valves for 1st, 2nd and 3rd family gases up to 200 mbar

Standard	Description
BS 1640- 3: 1968	Steel butt-welding pipe fittings for the petroleum industry Part 3: wrought carbon and ferrite alloy steel fittings. Metric Units.
BS 2633: 1987	Class I arc welding of ferritic steel pipework for carrying fluids
BS 2971: 1991	Class II arc welding of carbon steel pipework for carrying fluids
BS 3416: 1991	Bitumen-based coating for cold application, suitable for use in contact with potable water
BS 3799: 1974	Steel pipe fittings screwed and socket-welding for the petroleum industry
BS 4652: 1995	Zinc-rich priming paint (organic media)
BS 5041-1: 1987	Fire hydrant system equipment - Specification for landing valves for wet risers
BS 5041-4: 1975	Fire hydrant systems equipment. Specification for foam inlets and dry risers inlets
BS 5159: 1974	Specification for cast iron and carbon steel ball valves for general purposes
BS 5163-1: 2004	Valves for waterworks purposes. Predominantly key-operated cast iron gate valves. Code of practice
BS 5252: 1976	Framework for colour co-ordination for building purposes
BS 5266-1 : 2005	Emergency lighting Code of practice for the emergency lighting of premises
BS 5306-1: 1988	Hydrant systems, hose reels and foam inlets
BS 5306-3: 2003	Code of Practice for the inspection and maintenance of portable fire extinguishers
BS 5306-4: 2001	Specification for carbon dioxide systems
BS 5499-1: 2002	Graphical symbols and signs. Safety signs, including fire safety signs. Specification for geometric shapes, colours and layout
BS 5499-4: 2000	Safety signs, including fire safety signs. Code of practice for escape route signing

Standard	Description
BS 5654-2: 1979 (IEC 60478-2)	Stabilized power supplies, d.c. output. Method of specifying rating and performance
BS 5588-4 : 1998	Fire precautions in the design, construction and use of buildings. Code of practice for smoke control using pressure differentials
BS 6387: 1994	Performance requirements for cables required to maintain circuit integrity under fire conditions
BS 6724: 1997	Electric cables. Thermosetting insulated, armoured cables for voltages of 600/1000 V and 1900/3300 V, having low emission of smoke and corrosive gases when affected by fire
BS 7430: 1998	Code of practice for earthing
BS 7629-1: 1997	Specification for 300/500 V fire resistant electric cables having low emission of smoke and corrosive gases when affected by fire. Multicore cables
BS 7629-2: 1997	Specification for 300/500 V fire resistant electric cables having low emission of smoke and corrosive gases when affected by fire. Multipair cables
BS 7671: 2001	Requirement for electrical installation. IEE Wiring Regulations. Amendment 1 and 2 up to year 2004 included.
BS 7846: 2000	Electric cables, 600/1000V armoured fire resistant cables having thermosetting insulation and low emission of smoke and corrosive gases when affected by fire
BS 7854-1: 1996	Mechanical vibration. Evaluation of machine vibration by measurements on non-rotating parts. General guidelines
BS 7863: 1996	Recommendation for colour coding to indicate the extinguishing media contained in portable fire extinguishers
BS 7944: 1999	Type 1 Heavy Duty Fire Blankets and Type 2 Heavy Duty Heat Protective Blankets
BS 7974: 2001	Application of fire safety engineering principles to the design of buildings.
BS EN 3 –7: 2004	Portable fire extinguishers – Part 7. Characteristics, performance requirements and test methods

Standard	Description
BS EN 54-2: 1998	Fire detection and fire alarm systems – Part 2. Control and indicating equipment
BS EN 54-3: 2001	Fire detection and fire alarm systems – Part 3. Fire alarm devices. Sounders
BS EN 54-5: 2001	Fire detection and fire alarm systems – Part 5. Heat detectors. Point detectors
BS EN 54-7: 2001	Fire detection and fire alarm systems – Part 7. Smoke detectors. Point detectors using scattered light, transmitted light or ionisation
BS EN 54-10: 2002	Fire detection and fire alarm systems – Part 10. Flame detectors. Point detectors
BS EN 54-11: 2001	Fire detection and alarm systems for buildings – Part 11. Manual call points
BS EN 54-12: 2002	Fire detection and fire alarm systems – Part 12. Smoke detectors - Line detectors using an optical light beam
BS EN 545: 2002	Ductile iron pipes, fittings, accessories and their joints for water pipelines – Part 1- Requirements and test methods
BS EN 593: 2004	Industrial Valves - Metallic Butterfly Valves
BS EN 837-1: 1998	Pressure gauges – Part 1. Bourdon tube pressure gauges. Dimensions, metrology, requirements and testing
BS EN 1057: 2006	Copper and Copper Alloys - Seamless, Round Copper Tubes for Water and Gas in Sanitary and Heating Applications
BS EN 1092-1: 2002	Flanges and their joints, circular flanges for pipes, valves, fittings and accessories, PN designated – Part 1: Steel flanges
BS EN 1092-2: 2002	Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories, PN designated – Part 2: Cast iron flanges
BS EN 1092 –3: 2004	Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories, PN designated – Part 3: Copper alloy flanges

Standard	Description
BS EN 1171: 2002	Industrial valves: cast iron gate valves
BS EN 1254-1 and 2: 1998	Copper and copper alloys, plumbing fittings
BS EN 1515 –1: 2000	Flanges and their joints. Bolting. Selection of bolting
BS EN 1759-1: 2004	Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories, class-designated. Part 1- Steel flanges, NPS 1/2 to 24
BS EN 1567: 2000	Building Valves - Water Pressure Reducing Valves and Combination Water Reducing Valves - Requirements and Tests
BS EN 1838: 1999	Lighting applications. Emergency lighting
BS EN 1964-1: 2005	Transportable gas cylinders. Specification for the design and construction of refillable transportable seamless steel gas cylinders of water capacities from 0,5 litre up to and including 150 litres. Cylinders made of seamless steel with an Rm value of less than 1100 Mpa
BS EN 1982: 1999	Copper & copper alloys, ingots and castings
BS EN 10088-1: 2005	Stainless steels. List of stainless steels
BS EN 10095: 1999	Heat resisting steels and nickel alloys
BS EN 10216-1: 2002	Seamless steel tubes for pressure purposes. Technical delivery conditions
BS EN 10217-1: 2002	Welded steel tubes for pressure purposes. Technical delivery conditions. Non-alloy steel tubes with specified room temperature properties
BS EN 10220: 2002	Seamless and welded steel tubes. Dimensions and masses per unit length
BS EN 10217-1: 2002	Welded steel tubes for pressure purposes. Technical delivery conditions. Non-alloy steel tubes with specified room temperature properties
BS EN 10226-1: 2004	Pipe threads where pressure tight joins are made on the threads. Taper external threads and parallel internal threads. Dimensions, tolerances and designation
BS EN 10241: 2000	Steel threaded pipe fittings

Standard	Description
BS EN 10250-4: 2000	Open die steel forgings for general engineering purposes- Part 4 : Stainless Steels
BS EN 10253-1: 1999	Butt welding pipe fittings – Part 1 : Wrought carbon steel for general use and without specific inspection requirements
BS EN 10255: 2004	Screwed & socketed steel tubes and tubulars & for plain end steel tubes suitable for welding or for screwing to BS EN 10226-1 pipe threads
BS EN 10564: 1997	Soldering and brazing materials. Methods for the sampling of soft solders for analysis
BS EN 12101-3: 2002	Smoke and heat control systems. Specification for powered smoke and heat exhaust ventilators
BS EN 12101-6: 2005	Smoke and heat control systems. Specification for pressure differential systems
BS EN 12288: 2003	Industrial valves. Copper alloy gate valves
BS EN 12334: 2001	Industrial valves, cast iron check valves
BS EN 12845: 2003	Fixed fire fighting systems. Automatic sprinkler systems. Design, installation and maintenance
BS EN 13397: 2002	Industrial valves. Diaphragm valves made of metallic materials
BS EN 13789: 2002	Industrial valves. Cast iron globe valves
BS EN 50014: 1993	Electrical apparatus for potentially explosive atmospheres, General Requirements
BS EN 50020: 2002	Electrical apparatus for potentially explosive atmospheres, Intrinsic safety ‘i’
BS EN 50172: 2004	Emergency escape lighting systems
BS EN 50200: 2006	Method of test for resistance to fire of unprotected small cables for use in emergency circuits
BS EN 50266 (part 1, part 2-1 to part 2-5)	Common test methods for cables under fire conditions. Test for vertical flame spread of vertically-mounted bunched wires or cables

Standard	Description
BS EN 50267-2: 1999	Common test methods for cables under fire conditions. Tests on gases evolved during combustion of materials from cables. Procedures. Determination of degree of acidity of gases for materials by measuring pH and conductivity. Determination of degree of acidity of gases for materials by measuring pH and conductivity
BS EN 50347: 2001	General purpose three-phase induction motors having standard dimensions and outputs. Frame numbers 56 to 315 and flange numbers 65 to 740
BS EN 60034-1: 2006	Rotating electrical machines _ Part 1: Rating and performance
BS EN 60034-5: 2005	Rotating electrical machines – Part 5:Degrees of protection provided by the integral design of rotating electrical machines (IP code). classification
BS EN 60034-6: 1994	Rotating electrical machines – Part 6: Methods of cooling (IC Code)
BS EN 60034-9: 2005	Rotating electrical machines – Part 9:Noise limits
BS EN 60034-12: 2002	Rotating electrical machines – Part 12: Starting performance of single-speed three-phase cage induction motors
BS EN 60268	Sound System Equipment
BS EN 60332-2-2: 2004	Tests on electric and optical fibre cables under fire conditions – Part 2-2: Tests for vertical flame propagation for a single small insulated wire or cable -Procedure for diffusion flame
BS EN 60439 –1: 1999	Low-voltage switchgear and controlgear assemblies. Type-tested and partially type-tested assemblies
BS EN 60529: 1992	Degrees of protection provided by enclosures
BS EN 60598-1: 2004	Luminaires Part 1: General requirements and tests
BS EN 60598-2-22: 1999	Luminaires part 2-22: Particular requirements – Luminaires for emergency lighting
BS EN 60702-1: 2002	Mineral insulated cables and their terminations with a rated voltage not exceeding 750V Part 1 cables

Standard	Description
BS EN 60849: 1998	Sound systems for emergency purposes
BS EN 60947-1: 2004	Low-voltage switchgear and controlgear Part 1: General rules
BS EN 60947-4-1: 2001	Specification for low-voltage switchgear & controlgear – electromechanical contactors & motor starters
BS EN 61000-6-3: 2001	Electromagnetic compatibility (EMC). Generic standards. Emission standard for residential, commercial and light-industrial environments
BS EN 61000-6-4: 2001	Electromagnetic compatibility (EMC). Generic standards. Emission standard for industrial environments
BS EN 61034-1 : 2005	Measurement of smoke density of cables burning under defined conditions. Test apparatus
BS EN 61034-2 : 2005	Measurement of smoke density of cables burning under defined conditions. Test procedure and requirements
BS EN 61204-6: 2001	Low voltage power supplies, d.c. output. Requirements for low-voltage power supplies of assessed performance
BS EN 61951-2: 2003	Secondary cells and batteries containing alkaline or other non-acid electrolytes. Portable sealed rechargeable single cells. Nickel-metal hydride.
BSISO/TR 13387: 1999 (Part 1 to Part 8)	Fire Safety Engineering
CIBSE Guide E: 2003	Fire Engineering
IEC 60079	Electrical apparatus for explosive gas atmospheres. All parts
IEC 60754 – 1 : 1994	Test on Gases Evolved During Combustion of Materials from Cables - Part 1: Determination of the Amount of Halogen Acid Gas
IEC 60754 – 2 : 1991	Test on Gases Evolved During Combustion of Electric Cables; Part 2: Determination of Degree of Acidity of Gases Evolved During the Combustion of Materials Taken from Electric Cables by Measuring pH and Conductivity
IEC 61034-1 : 2005	Measurement of Smoke Density of Cables Burning Under Defined Conditions - Part 1: Test Apparatus

Standard	Description
IEC 61034-2 : 2005	Measurement of smoke density of cables burning under defined conditions – Part 2: Test procedure and requirements
ISO 7-1: 1994	Pipe threads where pressure-tight joints are made on the threads - Part 1: Dimensions, tolerances and designation
ISO 7-2: 2000	Pipe threads where pressure-tight joints are made on the threads -- Part 2: Verification by means of limit gauges
ISO 65: 1981	Carbon Steel Tubes suitable for screwing in accordance with ISO 7-1 – second edition
ISO 2954: 1975	Mechanical Vibration of Rotating and Reciprocating Machinery – requirements for instruments for measuring vibration severity
ISO 3864: 1984	Safety colours and safety signs
ISO 7005-1:1992	Metallic Flanges: Steel Flanges
ISO 9001: 2000	Quality Management systems -- Requirements.
ISO 9692-1: 2003	Welding and allied processes – Recommendations for Joint Preparation – Part 1 : manual metal-arc welding, gas shielded metal-arc welding, gas welding, T/G welding and beam welding of steels
ISO 10294-1: 1996; ISO 10294-2: 1999 & ISO 10294-3: 1999	Fire resistance tests -- Fire dampers for air distribution systems -- Part 1: Test method Fire resistance tests -- Fire dampers for air distribution systems -- Part 2: Classification, criteria and field of application of test results Fire resistance tests -- Fire dampers for air distribution systems -- Part 3: Guidance on the test method
ISO 10814: 1996	Mechanical Vibration – Susceptibility and sensitivity of machines to unbalance
ISO 14520-1 to 15	Gaseous Fire Extinguishing Systems
PD 5500 : 2006	Specification for unfired fusion welded pressure vessels
NFPA 10: 2007	Standard for portable fire extinguishers
NFPA 12: 2005	Standard on carbon dioxide extinguishing systems

Standard	Description
NFPA 72: 2007	National fire alarm code
NFPA 92A: 2006	Recommended Practice for Smoke-Control Systems. Pressure Differences Standard for Smoke-control system utilizing barriers
NFPA 101: 2006	Life Safety Code
NFPA 101A: 2007	Guide on alternative approaches to life safety
NFPA 2001: 2004	Standard for clean agent fire extinguishing systems
UL 555S: 1999	Safety Standard for Smoke Dampers
UL 2127: 1999	Safety Standard for Inert Gas Clean Agent Extinguishing System Units
UL 2166: 1999	Safety Standard for Halocarbon Clean Agent Extinguishing System Units

ANNEX II

STANDARDS AND REQUIREMENTS TO SATISFY FIRE SERVICES DEPARTMENT

The fire services installation shall comply with the following standards and requirements as required by the Fire Service Department unless otherwise approved by the Architect.

a.	Loss Prevention Council Rules for Automatic Sprinkler Installations (including all the LPC Technical Bulletins, Notes, Commentary, and Recommendation) incorporating BS EN 12845 : 2003, FSD Circular Letter No. 3/2006, and all the subsequent amendments by the FSD
b.	Rules of the Fire Offices' Committee, United Kingdom, for Automatic Sprinkler Installations, BS 5306 Part 2:1990, FSD Circular Letter No. 2/94, and previous edition of Loss Prevention Council Rules for Automatic Sprinkler Installations including Notes, Commentary, Recommendations and Technical Bulletins (only to be used where specified for existing installations and as approved)
c.	Loss Prevention Council Rules for Automatic Fire Detection and Alarm Installations for Protection of Property (Schedule for the use of BS 5839 : Part 1 : 1988), BS 5839 : Part 1 : 1988, FSD Circular Letter No. 1/2002, and all the subsequent amendments by the FSD
d.	Rules of the Fire Offices' Committee and Fire Offices' Committee of Ireland, United Kingdom, for Automatic Fire Alarm Installations for the Protection of Property (only to be used where specified for existing installations and as approved)
e.	Rules of the Fire Offices' Committee, United Kingdom, for the Installation of External Drenchers